NATIONAL PETROLEUM NEWS

July 3, 1946
Vol. 38—No. 27

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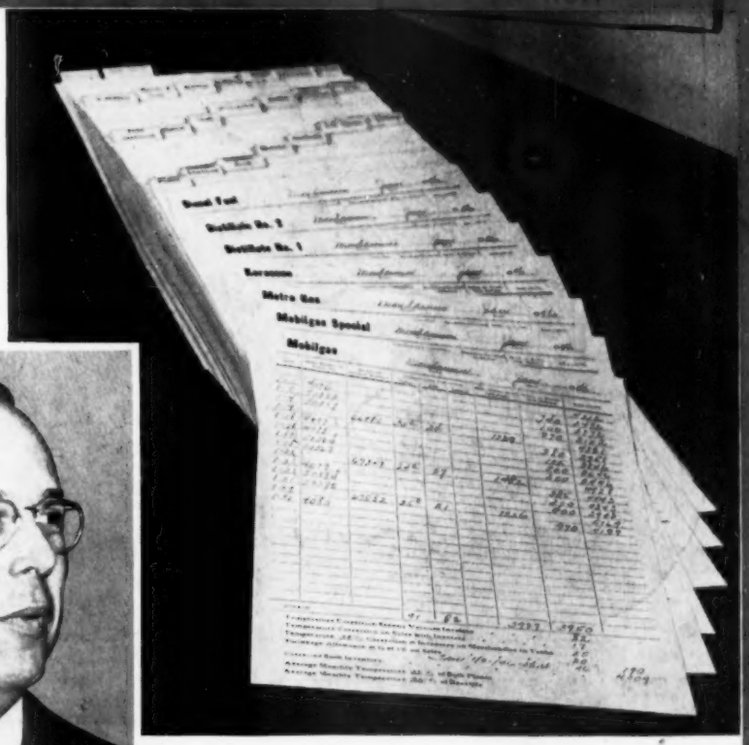
DETROIT

Bookkeeping, Sales Incentives Build Profitable Business

A combination of good bookkeeping, a unique sales incentive plan and good promotion of TBA has been profitable for the Nebraska-Iowa Oil Co. The management policies are formulated by Leroy L. Snyder, company president, who believes that the bookkeeping department is at least as important as the sales unit in his business. The greater the volume of sales made by his dealers and salesmen the *larger percentage* of profit they make — and they really go after the higher rate as evidenced by an ever increasing volume in the company's business. See p. 25.

Leroy L. Snyder—president, Nebraska-Iowa Oil Co.



The Nebraska-Iowa Oil Co. keeps a card record for each product at each bulk plant. These cards show the inventory of products at the bulk plants and in addition show at a glance how the inventory was calculated

IF YOU KEEP A PERMANENT FILE OF NPN

This issue of NPN is slightly larger than your previous copies; and, starting with the first issue in September, there will be a small reduction from this page size.

Both changes are due to our policy of conforming to standards adopted by most business paper publishers in co-operation with other interested groups for the purposes of paper conservation, convenience to readers, economy and speed.

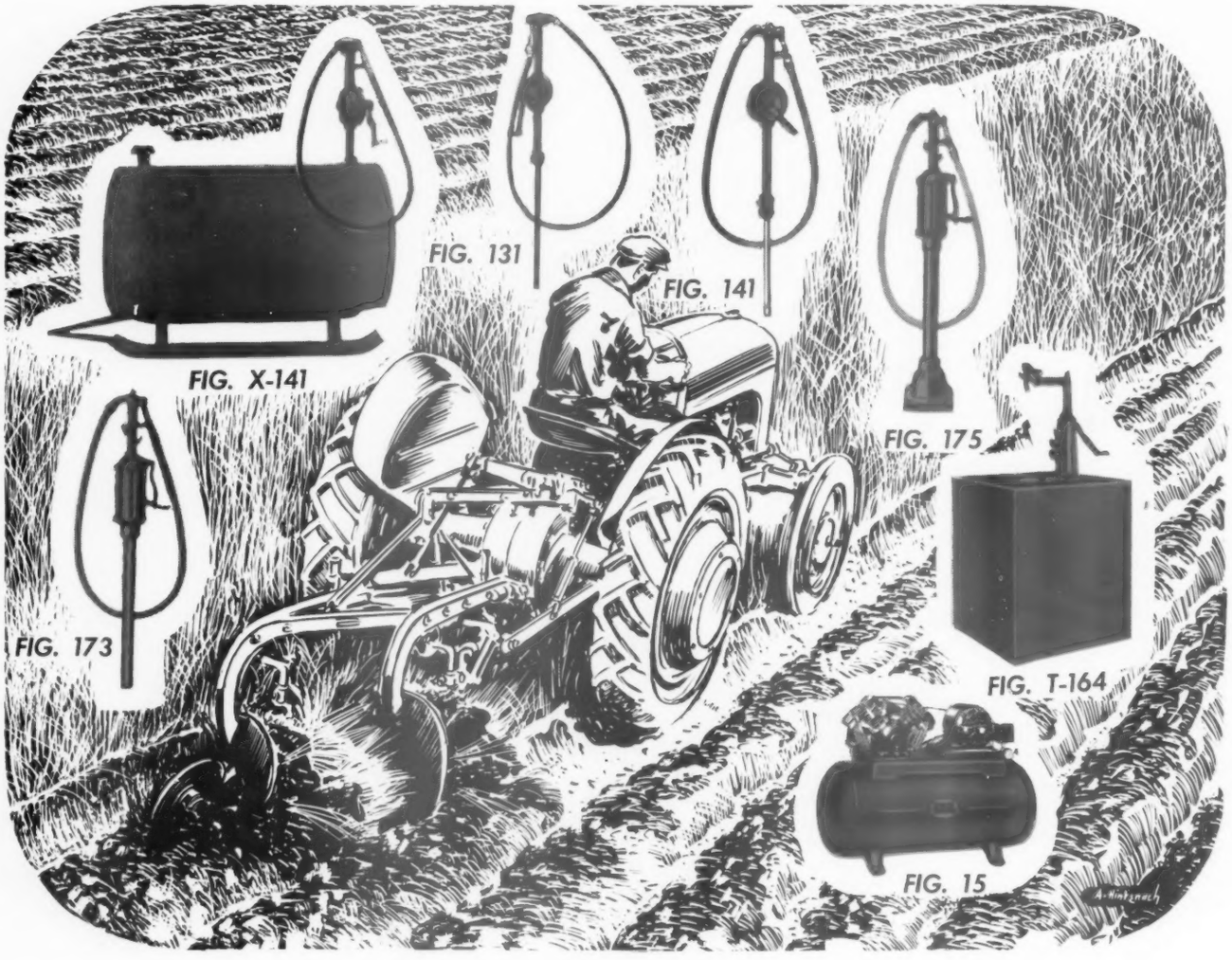
In NPN's case, two changes are necessary because prior commitments on paper supply prevent our making a change in page size immediately upon its adoption by the publishers' association. Paper is very scarce and we are doing our utmost to protect our readers by making our paper commitments and purchases far in advance.

So far as we can tell now the September size is likely to become a long-time standard.

NEW FEATURES IN THIS ISSUE

Two new features—a complete table of contents on page 3 and Ahead of the News on page 5—start with this issue of National Petroleum News. Ahead of the News will be written each week by members of NPN's large full-time staff to report to readers, clearly and concisely, what they see ahead in the oil industry.

R V38 3 July-Sept. 1946



MORE FARM FUELING . . . MORE FOOD

THE U. S. FARMER continues to be a most important factor in the welfare of our country, and of others across the seas. Stocks of canned foods are at their lowest . . . even below wartime levels. This condition means that more crop production is essential, which certainly calls for more mechanized equipment . . . more fueling units on the farm. Such mechanization will attract vitally needed workers to the farm.

We, at the Erie Meter Systems Inc., have the plant, the skilled and loyal personnel. Lack of material, with us, as in all industry, is our single obstacle that prevents the record production of **ERIE** Equipment for Farms, Service Stations and Airports.

July 4th we celebrate Independence Day, fully aware that world independence is largely in the hands of our American Farmer.

Look to **ERIE**

ERIE METER SYSTEMS, INC.

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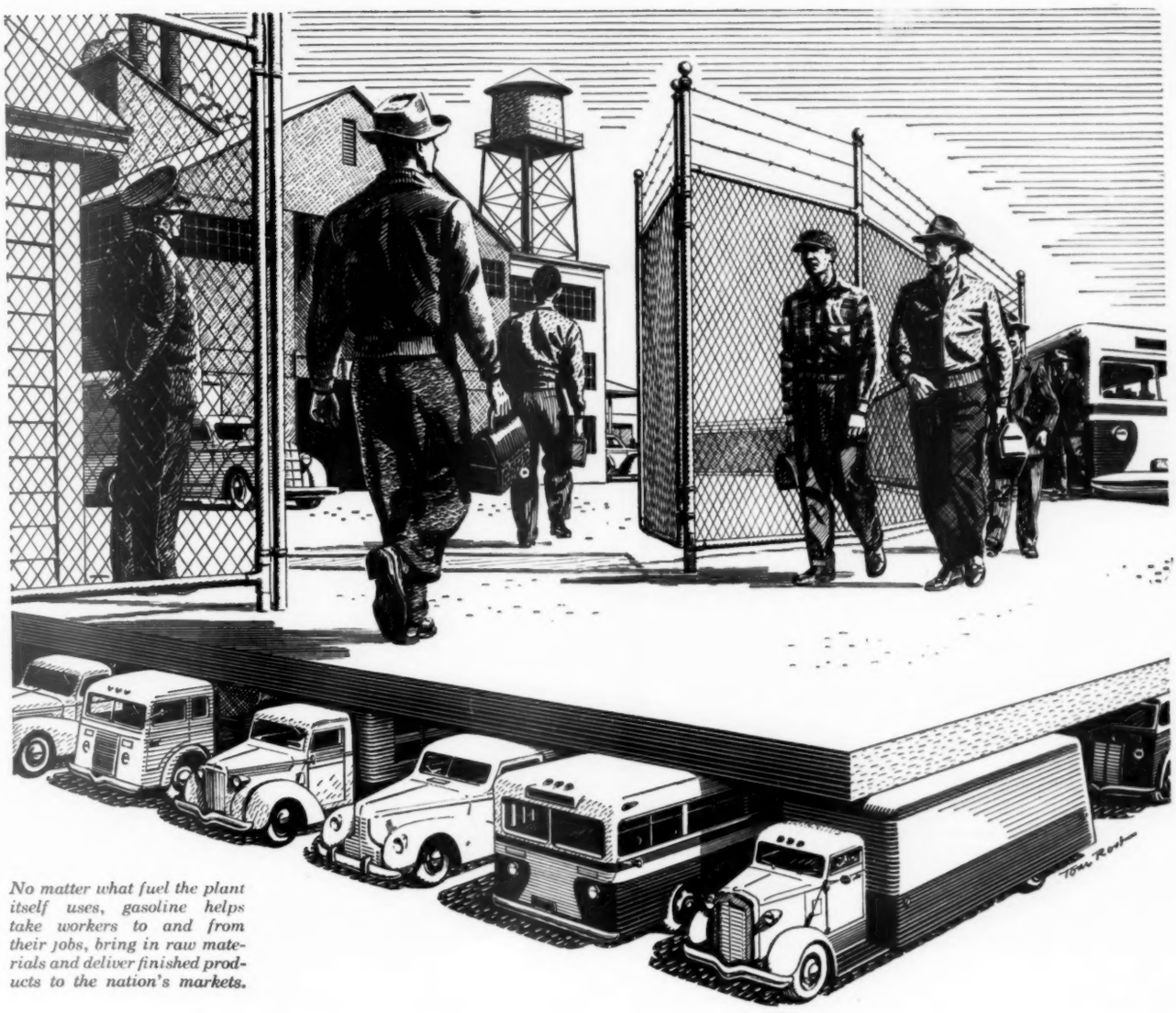
Tech



No matter what fuel the plant itself uses, gasoline helps take workers to and from their jobs, bring in raw materials and deliver finished products to the nation's markets.

Industry runs on gasoline

IT WOULD be impossible to draw a complete picture of modern industry without including cars, trucks, buses and other types of gasoline-powered equipment. Gasoline transportation is so much a part of the American industrial scene that *everyone* benefits each time its cost is reduced.

During the past twenty years such reductions have been many. By improving their refining processes and using antiknock fluid made by Ethyl, oil refiners have been able to produce gasolines of increasingly higher quality. And each improvement in gasoline has in turn made possible the development of more powerful, more efficient engines to provide better transportation at lower cost.

Because better fuels and better engines depend so much upon each other, Ethyl's research and service organizations have always worked closely both with refiners who use our product and with engine builders who are eager to get the most out of every improvement in gasoline quality. Ethyl Corporation, Chrysler Building, New York 17, N. Y.

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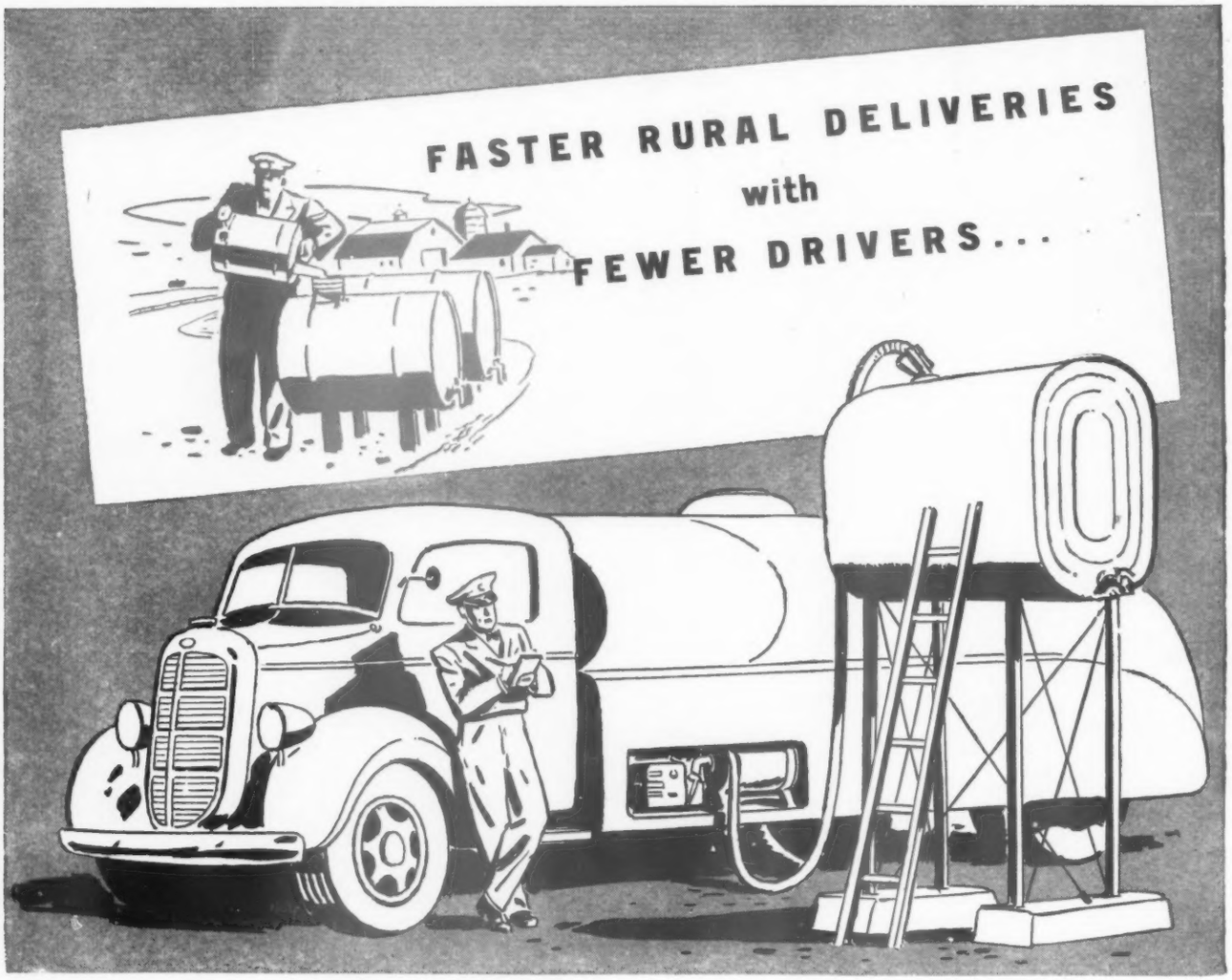

Help yourself . . . and your manpower situation, too . . . change *now* from bucketing to metered deliveries and you benefit these four ways:

1. Speed deliveries—make more customer stops per day.
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4. Do away with bucket-counting errors—eliminate disputes over deliveries, keep customers better satisfied.

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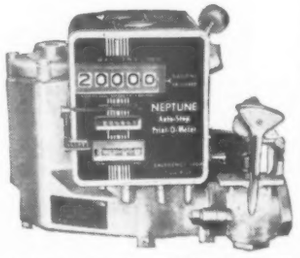

The "Compact-Type" Red Seal Meter for tank trucks combines in one complete assembly all the equipment necessary for accurate metering. Auto-StopP rint-O-Meter Register shown.

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NATIONAL PETROLEUM NEWS

Vol. 38—No. 27 ESTABLISHED 1909 **July 3, 1946**

THE NEWS WEEKLY OF THE OIL INDUSTRY

COMING MEETINGS

JULY

American Petroleum Institute, regional meeting, Division of Marketing, Denver, Colo., July 10.

Georgia Independent Oil Men's Assn., Hotel Dempsey, Macon, Ga., July 24.

AUGUST

Interstate Oil Compact Commission, summer quarterly meeting, Pantlind Hotel, Grand Rapids, Mich., Aug. 8-10.

Society of Automotive Engineers, West Coast Transportation & Maintenance meeting, Hotel New Washington, Seattle, Wash., Aug. 22-24.

SEPTEMBER

Michigan Petroleum Assn., fall convention, Park Place Hotel, Traverse City, Mich., Sept. 10-11.

Chicago Section, American Chemical Society, Coliseum, Chicago, Sept. 10-14.

Society of Automotive Engineers, Tractor Meeting, Hotel Schroeder, Milwaukee, Wis., Sept. 11-12.

National Petroleum Assn., 44th annual meeting, Hotel Traymore, Atlantic City, N. J., Sept. 18-20.

National Butane-Propane Assn., annual convention, Continental Hotel, Chicago, Sept. 23-25.

Indiana Independent Petroleum Assn., fall convention, Hotel Severin, Indianapolis, Sept. 26-27.

Rocky Mountain Oil & Gas Assn., quarterly board meeting, Northern Hotel, Billings, Mont., Sept. 27-28.

National Lubricating Grease Institute, 14th annual meeting, Edgewater Beach Hotel, Chicago, Sept. 29-Oct. 2.

OCTOBER

Empire State Petroleum Assn., Hotel Commodore, New York City, Oct. 1-3.

American Assn. of Oilwell Drilling Contractors, annual meeting, Plaza Hotel, San Antonio, Tex., Oct. 1-2.

Society of Automotive Engineers, Aeronautic (Autumn) & Aircraft Engineering Display, Hotel Biltmore, Los Angeles, Oct. 3-5.

American Institute of Mining & Metallurgical Engineers, Petroleum Division, annual meeting, Galvez Hotel, Galveston, Tex., Oct. 3-5.

National Assn. of Credit Men, Petroleum Division, fall conference, Roosevelt Hotel, Oct. 9-11.

West Virginia Petroleum Assn., meeting at Daniel Boone Hotel, Charleston, W. Va., Oct. 16.

Society of Automotive Engineers, Transportation and Maintenance Meeting, Hotel Knickerbocker, Chicago, Oct. 16-17.

Texas-Midcontinent Oil & Gas Assn., Rice Hotel, Houston, Oct. 16-18.

American Institute of Mining & Metallurgical Engineers, Petroleum Division, Ambassador Hotel, Los Angeles, Oct. 24-25.

Tennessee Oil Men's Assn., annual fall meeting, Peabody Hotel, Memphis, Tenn., Oct. 27-29.

Independent Petroleum Assn. of America, annual meeting, Fort Worth, Oct. 28-30.

NOVEMBER

South Dakota Independent Oil Men's Assn., Alex Johnson Hotel, Rapid City, S.D., Oct. 29-30.

Petroleum Division, National Assn. of Credit Men, annual convention, William Penn Hotel, Pittsburgh, Nov. 4-5-6.

American Petroleum Institute, annual convention, Stevens Hotel, Chicago, Nov. 11-14.

Rocky Mountain Oil & Gas Assn., annual meeting, Shirley-Savoy Hotel, Denver, Nov. 21-23.

Contents

NEWS SECTION **11**

FEATURE INDEX

SALES INCENTIVES AND GOOD BOOKKEEPING—How an oil jobber in a small Nebraska town uses these tools to build gallonage and profits. The story of Leroy Snyder and the Nebraska-Iowa Oil Co. **25**

WALTER S. HALLANAN, PERSONALITY SKETCH—A timely story about the man who is one of the leaders in oil's fight against OPA regulation and is temporary chairman of the National Petroleum Council. **36**

WAGE-HOUR LAW DECISIONS ANALYZED—Hubert Fuller, general counsel of the Ohio Petroleum Marketers Assn., discusses recent Wage-Hour Law decisions of the Supreme Court and tells how they may affect oil jobbers. **42**

POWER OIL DECISION, VICTORY FOR JOBBERS—Staff Writer Frank C. Sturtevant explains why the Federal District Court decision, dismissing a Wage-Hour Law suit against Power Oil Co., is a victory for the jobber. **44**

WORKERS' OUTPUT AT NEW LOW—Report from Bureau of Labor Statistics shows output per manhour of refinery workers reached seven-year low in 1945. Unit labor costs soaring. **46**

WANT SALESMEN, NOT 'ORDER TAKERS'—Oil marketing needs salesmen to replace the current crop of 'order takers'. That's the opinion of Wisconsin marketing men interviewed by an NPN staff writer. **60**

DEPARTMENTS

Advertisers' Index **62**
Ahead of the News **5**
Atlantic Coast Comment **9**
Editorially Speaking **21**
Gasoline Consumption by States **60**
Midwest Comment **7**
Markets **50**
Oil Prices **52**
Oil Transportation News **48**
Personals **63**
Refining News **46**
Statistics **56**
Washington Comment **7**

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AHEAD *of the* NEWS

BEYOND BIKINI—Dropping of the atom bomb on the guinea pig fleet at Bikini will not mean nearly so much to the oil industry as will research right at home which the Navy is conducting into atomic energy for power purposes. Rear Adm. Harold G. Bowen, chief of the Navy's Office of Research and Inventions, believes it quite likely that atomic instead of oil burning energy will be supplying propulsion power for Naval vessels within five years. The effect of the transition, he says, will be "as revolutionary as from sail to steam."

° ° °

IN THE WIND—Justice Department is toying with idea of dismissing charges against 60 or 70 defendants in API antitrust suit. Purpose apparently would be to weed out those against whom D. J. thinks its case is weakest, preparatory to bringing suit to trial. However, D. J. hasn't made up its mind on its next step, following breaking off of consent decree negotiations.

° ° °

MUCH ADO ABOUT NOTHING?—There's a growing feeling in oil and gas circles that, other than filling a good-sized room with voluminous records, nothing much will ever come of the FPC natural gas investigation which is now in its final stages. For one thing, complexion of FPC itself has changed somewhat since the investigation was started, with the result that the urge to reach out and control everything in sight now is not nearly so strong. For another, it is pointed out that even should the Commission come up with a few startling legislative proposals, Congressional action necessarily will be a long way off and industry will have every opportunity to marshal opposition on Capitol Hill.

° ° °

ANTI-FREEZE PROSPECTS—The CPA slant on the anti-freeze outlook for next Winter contains a strange mixture of good and bad. There'll be sufficient raw materials, including methanol, despite closing of wartime plants and loss of production during coal strike, CPA believes. But there aren't enough tin cans and steel drums to get the finished anti-freeze moving now in sufficient quantities to meet estimated demand this Winter. Although the agency asserts there will be adequate supplies of methanol for anti-freeze, other industrial users of the chemical will be short. To take care of these users the agency's chemical section is considering plans to seek priorities for private construction of additional methanol plants. One large plant, which produced methanol and ammonia during war, at Morgantown, W. Va., can't be used for methanol because government already has leased coke-producing facilities there to a steel company and CPA says use of the plant isn't feasible without the fuel processing system.

° ° °

MORE FROM THOMPSON—Look for more from Texas Railroad Commissioner Thompson on utilization by refiners of all petroleum hydrocarbons produced at the well. Commission engineers have made studies which, he says, indicate that the customary 2c per degree differential in crude price up to 40 gravity and above should continue beyond that level. Complete results of these and other studies will be announced in the Fall. Refiners, Thompson says, can realize close to 40c more profit from refining a barrel of 60 degree charge stock (crude and light products) than they can from refining a barrel of 40 degree crude. He wants the producer to get paid, proportionally, for his liquids as well as his crude.

° ° °

MONTHLY TO QUARTERLY—Permitted use of Ethyl fluid may go on a quarterly basis, beginning in October, instead of present month-to-month basis. CPA considered making the change as of July 1, only to decide that it would be better to observe the effects of L-355 (use order) for at least another three months before coming to any final conclusion.

° ° °

CUT FOR THE AAF—Although the House voted the full $90,000,000 recommended by the Budget Bureau for purchase of fuel and oil for Army aircraft, amount actually is $12,787,884 less than AAF said it would need to meet requirements in the fiscal year just starting.

° ° °

WHAT'S IN A NAME?—Interior Department's Oil & Gas Division will not use that name when fully organized, intention being to give it a title more in keeping with its role as a co-ordinating agency.

° ° °

REPAIR SHOP COMPETITION—Noted among CPA permits for new construction are many auto repair shops in all localities. This means that the shortage of auto repair facilities will be eased considerably, which, in turn, means that competition for repair work will be sharpened. Operating an auto repair shop as an adjunct to a service station then should be less attractive to service station dealers.

° ° °

SOUTHEAST MEETS WEST—An important Eastern independent, who thus far has operated principally in the Southeast, may soon enter a working agreement with one of the nation's major companies, which only recently entered the Middle Atlantic market. The rumor is that the independent would obtain products from this major, and would distribute them in New York, Connecticut, Massachusetts and Pennsylvania.

° ° °

TEXAS GOVERNOR'S RACE—Although much can happen before the Texas primary elections July 27, Texas Railroad Commissioner Jester is conceded a good chance of being in the run-off for governor. Likely to lead the ticket is Dr. Homer P. Rainey, deposed University of Texas president now running under the liberal banner. Dr. Rainey probably will get all the votes he is going to get in the first primary, and the man in the run-off with him will be the next governor.

Thinking it Through!

[NO. 5 OF A SERIES]

The Proposition **Provision for recycling gas oil should be included in any design for Fluid cat-crackers.**

The Facts Passing any material through a given piece of process equipment more than once at less than the maximum performance level would not, at first glance, appear to be a most economical use of that equipment. However, in cat-cracking, if maximum cracking is attempted in one contact of oil and catalyst, undesirably high percentages of coke and dry gas are obtained in the cracked products.

Experience has proved that for optimum product distribution about half of the fresh feed should be cracked during the first contact with catalyst. Yet experience has also proved that for maximum overall return from feed stock about three-fourths of the average charge should be converted into light products.

Both of these requirements can be satisfied through use of a recycling operation...achieving a high overall yield of profitable products without concurrent waste of feed stock due to over-cracking.

Thus for overall conversion efficiency . . . today and tomorrow . . . provision for recycling the gas-oil fraction is of utmost economic importance.

The Conclusion **There is no substitute for the *best* design.**

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★**ECONOMICS CONSULTATION**—Extended experience in the field of refinery economics enables Kellogg to give authoritative counsel in the petroleum field.

Mr. Yocom

WASHINGTON—by Herbert Yocom

Distrust Will Develop if Press Is Shut Out of NPC Meetings

Judging by Secretary of Interior Krug's press conference remarks this past week, it appears that future meetings of the new National Petroleum Council are to be held behind closed doors, just as was the first session.

He said, it is true, that the question has not been finally decided, but his further comment that for the Council to meet openly, with all comers welcome to watch from the sidelines, would be comparable to assembling in Madison Square Garden seems to leave little doubt as to where he stands on the matter.

° ° °

What we are about to add is not to be construed as self-serving argument, advanced solely for the purpose of securing admission of the representatives of this and other oil trade publications to the NPC meetings. Far from it, for one way or another the news of what transpires during the executive deliberations of almost any group can always be had.

Someone always is willing to talk and by contacting several such individuals any resourceful reporter can usually manage to put together a rather well-rounded story of what went on behind the barred doors. It is axiomatic that the news, like murder, generally will out, regardless of attempted secrecy, because the press, meaning in this case the trade press, knows how to take care of itself.

Our purpose rather is to suggest to Mr. Krug that he will be missing a great opportunity if, right at the outset of this joint government-industry venture, he should follow up what seems to be his inclination and actually draw the veil of secrecy around the activities of NPC.

If anything will breed suspicion as to the purposes and objectives of government in setting up, in peacetime, an NPC, it will be just such a thing as this. Immediately there will be much raising of eyebrows out in the industry. Being on the outside, there will be those who wonder just what is *really* going on among their few chosen brethren privileged to sit on the inside.

Wonderment will lead to speculation, speculation to rumor and rumor to confusion and eventual consternation, perhaps to the complete undoing of NPC itself.

Not even informed accounts in the trade press could prevent such a situation as this developing, as we see it, for no one possibly can be sure that the whole story has been told; that there is not some one mising piece which, if it were known, would throw an entirely different light on the activities of the Council.

° ° °

Thus, while conceding that men will express themselves more freely when they know they are not doing so for general consumption, it occurs to this corner that more would be gained than lost by Mr. Krug if he were to make NPC a forum whose doings are an open book to all in the industry.

Then, and only then, would he avoid the dangers inherent in any star chamber policy such as appears contemplated, for there is no better way to dispell suspicion and distrust than to conduct one's operations in a gold-fish bowl or, for that matter, in some such place as Madison Square Garden.

° ° °

Along with many others, we're able to get a huge laugh out of the President's letter accepting the resignation of "Dear Chet" Bowles as Economic Stabilizer.

"Your action," wrote the Chief Executive, "in submitting your resignation before the Senate has acted as an emphatic answer to the fantastic charge of spokesmen of selfish interests that you sought extension of the price control bill (law) in order to perpetuate yourself in office."

The truth of the matter, however—and this prompts the laughter—is that Mr. Bowles resigned because he knew that Congress just wasn't going to be a rubber stamp and give him the kind of a law he wanted, meaning one that would have left him free to continue in absolute control over the business economy of the country.

It makes no difference whether the Senate had or had not acted at the time of the decision to quit, for at that hour, if not Mr. Truman, certainly everyone else in this capital city knew that the jig was already up; that enactment of the legislation in the form it then stood was a foregone conclusion.

Mr. Lamm

MIDWEST—By Earl Lamm

Renewed Union Activity in Oil Gets Spotlight in Midwest

Oil company attorneys in the Midwest do not look with favor upon the growing practice of trade associations in writing over-all management contracts with labor unions.

It is well for Midwest oil men to become alert to the dangers of such contracts and to other labor problems in view of recent union activity affecting oil marketing in Detroit and Joliet, Ill.

While deploring the practice of trade associations and labor unions in signing joint agreements, the oil company attorneys pointed out well-staffed associations can give invaluable advice and support to their individual members in off-setting the heavier numerical weight of organized labor.

Where there is coercion in attempts to force employers into unions, the attorneys pointed out that employers may apply for court injunctions prohibiting interference, and may also seek redress for damages.

In discussing over-all union contracts made for management by trade associations, one of the attorneys called it a terribly short-sighted policy. Unions, most of all, want to deal on an industry or nation-wide basis, and he said every effort should be made to keep contracts on an individual or local unit company basis. Thus, contracts can be made to fit local circumstances as well as off-set the monopolistic ambitions of the unions.

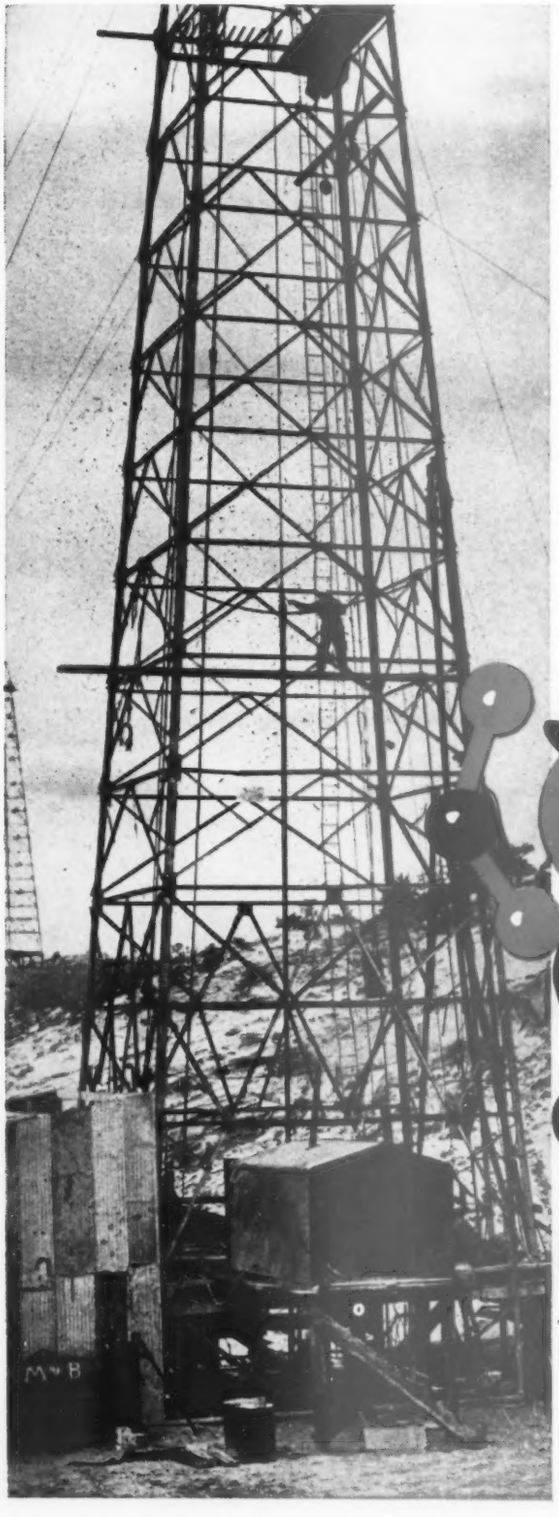
Another attorney pointed to the experience of ship owners, coal companies and railroads as bad examples of industry-wide, or broad basis, negotiation.

In cases where an industry group or trade association deals with a union, one member of the industry group inevitably rules the others by breaking down and submitting. The result is a poor situation for all. At best, any group or association fostering of contracts is a tendency encouraging union monopoly, the attorneys said and they have had experience in those particular matters.

° ° °

The present union difficulty at Joliet, Ill.—where a drive is on to organize dealers—is another flare-up of a situa-

"When you specify Perbunan...you get a rubber that's born of oil!"



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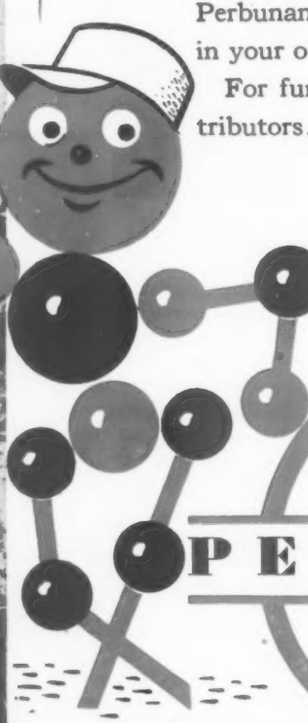

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tion that developed there during the war as result of government regulation of industry.

Dealers during the war were persuaded to join Local 176, AFL teamsters union for the purpose of carrying out PAW directive restricting service station hours, and 7 a.m. to 7 p.m. was agreed upon. One of the objectives of the union now is to continue those hours, and some dealers object to it, and have gone to court. Application for injunction was denied in the lower court and the two operators have appealed (see p. 16).

Three years ago, union leaders at Joliet testified in an OPA case against Joliet Oil Corp., operators of service stations there, who refused to join union. Case finally resulted in 20 day suspension by OPA for alleged ration violations. That company is not involved in the present labor difficulty, but it is interesting to recall now the tactics used by the union against those who resisted their wartime organizing campaign.

Oil is not the only goal of the teamster union at Joliet. Last week the local tried to organize grocery store and meat market owners, but they suddenly agreed to a truce until September, provided employers did not object to organization of employes.

Perhaps what is happening to the AFL teamsters local in Detroit, had some influence in quieting the Joliet organizers. Word from Detroit is that a one-man grand jury (which Michigan law authorizes) and a state prosecutor, Judge George B. Murphy and former Circuit Judge Lester B. Moll, are thoroughly investigating alleged union extortions. One union organizer was jailed for contempt of court. In Joliet as in Detroit, AFL teamster locals started out to organize oil marketing then expanded in an attempt to include grocery store and meat market owners.

Minimum of $4 each monthly dues from 300 or 400 service stations in Will County, Ill., plus dues from all the store and market owners would be a substantial sum—if the union ever got it. In Detroit, they were shooting at organization of 6,000 stores and markets, and made their first big effort last April.

Mr. Glassey

ATLANTIC COAST—by Frank P. S. Glassey

Institute Maps Campaign to Get Oil Heat Into GI Homes

The Oil-Heat Institute of America is going ahead with plans for a mass sales campaign of new equipment, despite shortages of material and the prospect that there may be a scarcity of fuel oil next fall and winter. This was made clear last week, in pronouncements by A. E. Hess, managing director of the Institute, and W. A. Matheson, its president, as well as in a meeting of the Joint Oil Heat Committee on Veterans' Housing.

The Institute has appointed a group of top executives to map a campaign designed to obtain a substantial portion of heating units in the government's housing program. Mr. Hess said that 'when the government buys something, the public construes the type of unit sold as 'government approved.' In a sense, it is approved, of course. But the approval is interpreted by the public in a much wider sense, and we want to be in on that resultant business."

Mr. Hess pointed out that there has been serious discussion among oil-heating unit manufacturers over standardization of equipment, and said that this would pave the way for mass production of low-cost heating units on an unprecedented scale.

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Mr. Matheson has time and again stressed the necessity for aggressive action on the part of the oil industry for its share of consumer dollars on a competitive market. During the committee meeting last week—attended by representatives of automatic oil-heating equipment manufacturers, distributors of equipment and fuel oil, independent fuel-oil distributors, and major oil companies—he said:

"It has become a common practice to refer to this Veterans' Building Program as a GI housing program, but I think that it is in actuality a pattern for an American housing program because the GI is the average American, both in desires and earning capacity.

"It would be a mistake to assume that the plans for our industry are plans which will be greatly changed at the conclusion of the veterans' housing task. The style of home, and the needs of the people who will eventually live in these homes, will change very little as this housing program goes on over the planned period of five years into a total of something in excess of 12,000,000 homes.

"There's a civilian housing need which can be met with the same types of homes and equipment going in them. For months the oil-heating industry has based its future plans on the expectation of doubling the present oil-heating installations by the end of the first five postwar years. That would mean approximately 5,000,000 installations in use.

"The figures and facts developed today make it appear that the requirements have been underestimated by about a million installations, and it's not impossible that we will have 6,000,000 installations operating at the end of the first five postwar years."

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J. H. Hart of the mechanical equipment section of the Federal Housing Administration told the oil-heat gathering that the housing situation will require careful planning and production of all branches of the heating industry and the use of all types of fuels to guarantee the total building result which the government is seeking to attain with the aid of private industry.

The Federal Housing Administration, Mr. Hart said, contemplates the use of many pre-fabricated houses, as well as those which will be produced under the building programs. All houses will be low heat loss type, with insulation. Space limitation, for the installation of equipment, will be a factor for consideration, and pre-fabricated housing particularly indicates a choice of automatic heating.

Mr. Hart said that FHA plans careful inspection of those houses which the agency will insure, and he suggested that insofar as possible, new equipment intended for use in veterans' houses should comply, for acceptance, with commercial standards already in effect and understood by the heating industry. He added that FHA already holds mortgages on hundreds of thousands of homes which have been equipped with oil-heating facilities and which have proven satisfactory, but he pointed out that space limitations in the new home planning may indicate that equipment which has been supplied in the past will be excess in capacity as well as in physical size, and that some engineering changes are probably an immediate necessity.

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Despite the optimistic forecasts, partially quoted above, production difficulties have resulted in a shortage of oil heaters, and have caused several manufacturers to withdraw exhibits in recent eastern expositions because of the impossibility of filling orders in the near future.

Mr. Hess pointed out last week that of 420,000 installations originally forecast for 1946, only 87,000 units were produced by all manufacturers during the first quarter of the year, and that although demand is still growing, production is still lagging.

Meanwhile, fuel oil suppliers are increasingly worried that the oil heating unit has been oversold, and they predict that many a householder who buys an oil heater this summer will be unable to obtain product with which to operate it this fall.

D. T. Ring Heads Pennsylvania Grade Crude Oil Association

D. T. Ring

Pennsylvania Grade Crude Oil Assn. last week at Pittsburgh elected an oil man of 20 years' standing to head the organization for the coming year (see p. 15). He is D. T. Ring, vice president in charge of production for Preston Oil Co. of Ohio, Union Gasoline & Oil Corp. of Pennsylvania and West Virginia, and Virginian Gasoline & Oil Co. of Kentucky and West Virginia.

A resident of Columbus, O., Mr. Ring is a native Ohioan. Born in Martins Ferry, O., he attended Ohio State University and was graduated in 1912 by Kent State College (now Kent State University) with a bachelor of science degree. Then he took post graduate work at the University of Chicago, specializing in geology.

In 1916 he entered the oil industry, becoming associated with Humphries Petroleum Corp. in Dallas. The next year he performed his first geological work in the Southwest, working in fields in Texas, New Mexico, Arkansas, Louisiana, Mississippi, Oklahoma and Kansas. For nine years he carried on as a geologist. During this time he also was associated with F. Julius Foha in the Midcontinent and Gulf Coast areas.

Columbia Oil and Gasoline Corp. beckoned in 1927 and he returned to Ohio and began work in the production department at Columbus, O. In 1929 he was placed in charge of oil production for the Columbia system and since March, 1939, has been vice president in charge of production for Preston, Union and Virginian as mentioned previously.

Mr. Ring has been a director of Pennsylvania Grade Crude Oil Assn. for seven years and its second vice president for five years. He is a member of the General Production Committee of API, chairman of API Central Committee's district activities and past chairman of API Eastern District.

He is vice president for Ohio of Independent Petroleum Assn. of America and a member of the Advisory and Research Committee on Oil for Ohio and Ohio State University. Mr. Ring served on PIC for District One, PAW and is a member of the OPA committee on subsidy payments for Ohio.

Mr. Ring has one son, James DeWitt Ring, 21, who has just returned from service in the Navy where he was an electrician aboard a tanker. He is now preparing to enter college.

No Immediate Oil Price Increase Foreseen as OPA Fades

25c Boost in Crude Looms Unless Congress Acts Soon; Industry Adopts 'Wait and See' Attitude

NPN News Bureau

CLEVELAND—The oil industry has adopted a "wait and see" attitude following the weekend dethroning of OPA.

Consensus among oil leaders is that industry as a whole will abide by the request of President Truman to stand by and await congressional action. However, virtually all oil men ventured opinion that unless Congress acts within next 10 days, industry will proceed on assumption that price controls are permanently off and will conduct business on that basis.

Most oil men contacted by NPN said crude prices can be expected to rise about 25c, the same figure mentioned in numerous congressional hearings and the one proposed by the industry advisory committee in price hearings. No substantial evidence of other price increases was revealed in an industry check.

Producers expressed belief crude price rise would be made to the extent of absorbing stripper well subsidies ranging from 35c to 75c. However, they felt the increase would not necessarily advance as much as 75c (top subsidy rate), but would instead go up only to the extent it is felt the market can stand it—probably about 25c average. Survey indicates 25c boost will bring about only slight increase in petroleum products. But no sharp price rise is anticipated.

While the industry thus was evidencing its intention to maintain, insofar as economically possible, stable price levels, the House on July 1, by an overwhelming vote of 283 to 61, adopted a resolution continuing OPA for 20 days. Senate had not yet acted at NPN press time and expectation was that it might be several days before that group would reach a vote.

OPA Fuel Price Division stayed on the job, even Acting Chief J. H. Reppart being at his desk July 1 after an extended absence due to illness. Possibility of any oil price actions being taken during life of stop-gap law, should it finally be adopted, was considered slight, however, for the same reasons—political considerations—that prompted OPA to sit on its hands while Congress debated bill which Truman vetoed June 29.

Warns Against Hasty Action

Hope that industry "will not take hasty action on price matters" was expressed by IPAA President Hardey, who added: "The industry has suffered long waiting for these price adjustments to be made. But I hope no effort by the industry will be made to correct them until Congress has had time to make necessary review of the situation in which we now find ourselves."

Commenting on Truman's veto, IPAA General Counsel Russell B. Brown had this to say: "I am afraid the President was persuaded by the same twisted little minds that have brought us to the shameful position we now occupy. Certainly he has repudiated his experienced congressional leaders."

Majority Leader Barkley, near the close of Senate debate on OPA conference report commented:

"I know of no reason, so far as supply and demand are concerned, why petroleum should be any longer maintained under control with price ceilings."

This indicates that should Congress finally enact an extension bill which meets with the approval of the administration, chances for oil decontrol will not be endangered and may be enhanced as a result of Sen. Barkley's statement.

Meanwhile, this is the industry picture at NPN press time as regards petroleum prices as obtained in an NPN survey:

Midwest—One oil company official expressed the general attitude here when he said, "The oil industry is too intelligent, competitive and level-headed to jeopardize its standing in the public's eye by going off half-cocked and raising prices. There may, however, be some adjustments where abnormal market conditions exist."

Although no official would allow himself to be quoted, statements indicate a policy of "sitting tight so as to make no untoward move at this time."

"It would take several weeks to bring back to a competitive level adjustments existent in many areas," one official stated. "However, I look for an overall advance of 25c in crude prices, but this too will depend on quality, demand and locality."

Executive of one major oil company asserted developments hinge on what happens to crude. He feared producers might advance crude immediately. Same executive said his company would not raise prices unless crude rises.

Michigan refiners saw no immediate general advance in prices. They pointed out that gasoline market is highly competitive and, as far as local market (Michigan) is concerned, gasoline in some instances currently is being offered at 1.25c under former OPA ceilings.

Residual fuels prices might rise but recently even the demand for these oils has slackened, these refiners report. Price of crude, they add, of course governs the refined prices.

Midcontinent — Most oil officials in area say they are waiting to see what Congress will do, one oil man expressing the opinion lawmakers would act speedily. Small refiner with no production of his own said any crude price increase would hurt. Generally speaking, most company executives anticipated no immediate price increases.

Forecast that crude price rise would be about 25c was made by several Midcontinent oil men. One official declared the spot refined market would go up before crude price advance since the latter would be so widely publicized. He foresaw no rise in natural gasoline prices.

Pennsylvania—George J. Hanks, president, South Penn Oil Co., Bradford, Pa., said buyers in that area have indicated they plan to "sit tight" for a few days and abide by President Truman's request to put off any price increases for a while at least.

Mr. Hanks said the price of Pennsylvania grade crude would go up if OPA is permanently abolished. He explained that the rise would be necessary to offset the 75c subsidy paid stripper well operators but, he added, the increase would be only a percentage of the full subsidy.

A few other Pennsylvania oil men said Penn-grade crude might rise as much as 75c but consensus was that price rise would be gradual and be made on the basis of what the market could stand. Reports indicate Penn-grade crude rise would be higher than that for other crudes because of the lower subsidies paid in other regions.

Western Pennsylvania refiner observed, "We don't expect any immediate price changes. If we have to pay the equivalent of price subsidy or bid for crude, our prices will go up. Bright stock may go up 5c and cylinder stocks 10c regardless of what happens to OPA."

Another refiner declared, "We won't know what we're doing until we have better information on the subsidy. I believe it will be restored, but if it isn't the price structure certainly will be affected because we haven't enough crude in Pennsylvania as it is."

Atlantic Coast—Prices of crude oil and products probably will not be increased as result of impasse over OPA extension, according to survey of 10 major companies here. Boards of directors of several majors met July 1 and voted to

make no change in prices while fate of OPA remained in balance.

One major spokesman, however, disagreed with this, saying the tendency of some refiners will be to raise prices to try to get crude and that others may have to follow along.

General belief was that if OPA is killed definitely, crude prices will advance 25c per bbl. and that product prices would be increased accordingly. Vice president and sales manager of one company said:

"Costs are up 50 to 60% above prewar. When a free market exists crude will advance 25 to 30c a bbl., and then products will increase accordingly."

Another executive declared, "If OPA is definitely ended there will be a 25c rise in crude within 60 days. Then gasoline will go up one cent per gallon, fuel oil 0.5c to .75c and there will be a proportionate increase in motor oils."

Reflecting the viewpoint of independents, Clyde G. Morrill, secretary of Atlantic Coast Oil Conference, said in Boston there probably will be no immediate reflection of OPA's demise, "unless something happens to crude." He said if OPA were to expire without extension during this session of Congress, "crude prices probably would advance and products would rise to some extent. Heavy oil would increase definitely. Then there would be some fluctuation and some general setback in prices thereafter."

Texas—Survey here revealed no price changes with none expected in the immediate future.

"The industry is going to sit tight and not be silly," said James P. Nash, Austin independent producer who would benefit by a price raise in crude. "If prices are kept at an even keel we can get Congress to forget about an OPA."

He hoped that present prices would hold for perhaps 60 days and said that information on hand was that a 25c hike is in the offing, which, he said, was long overdue.

All officials of Humble Oil and Refining Co., state's largest crude purchaser, were closeted in a tight conference early this week and could not be reached for comment.

Companies such as Humble, however, which buy more oil than they produce, are certainly in no hurry to advance crude prices and are not likely to do so in the present OPA-less period. One of company's public relations staff told NPN that it is extremely unlikely that Humble will change its present policies any time soon.

In Houston, H. J. Porter, president, Texas Independent Producers and Royalty Owners Assn., which has been clamoring for a price rise in crude, predicted that there will be an immediate 25c raise but anticipated no "inflationary" rise. With OPA out of the way, the law of supply and demand will prevail, he said, adding that a price increase of as much as 25c would not be inflationary but would "right a wrong" which has existed all during the war.

Col. Thompson of Texas Railroad Commission was quoted by press dispatches from Amarillo as saying that a 25c crude price rise should come "momentarily."

Oil Equipment Makers See No Spurt in Supplies; Say Competition Will Keep Most Prices Stable

NPN News Bureau

CLEVELAND—Oil equipment manufacturers, surveying the market in the wake of the surprise demise of OPA last weekend, told NPN this week there was little hope that the flow of equipment needed by the oil industry would be greatly increased in the near future, even if OPA is permanently abolished.

Same manufacturers foresaw no immediate nor sharp increases in prices, expressing the viewpoint that a return to competitive enterprise will keep price levels on an even keel and will serve to stave off any unreasonable increases.

G. Denny Moore, secretary of Gasoline Pump Manufacturers Assn. of America, summed up the situation in these words:

"There can be no immediate effect on most equipment because most bottlenecks, such as motor manufacture, are natural ones. The outlook for deliveries is not good until we see a supply of motors."

Clyde G. Morrill, secretary of Atlantic Coast Oil Conference, said that regardless of OPA's possible end, there will be no immediate deliveries of trucks in large quantities, while "service station equipment is being produced in as large as possible quantity now, including pumps."

Purchasing agent for one major company said lifting of OPA ceilings would mean a 10 to 15% increase in price of most oil company equipment, but that there will be "no gain in quantity of production and delivery this year." Another purchasing representative said that service station and refinery equipment have been held up by strikes, with lack of motors chiefly responsible. He added that the end of OPA would not remedy that situation immediately.

A third said that death of OPA may mean that "labor will end its strikes and equipment deliveries will improve, but that improvement will be very gradual."

Sales manager of company producing air compressors told NPN his company is going to look over costs of various items and then arrive at a price giving company and jobbers a fair margin of profit. He believed other manufacturers would follow a similar procedure before getting out price lists.

This official said that under OPA system prices have been out of line on many items. With the return of competition, he asserted, overall equipment prices will, in 60 to 90 days, be on an equitable basis. There might be some increases but competition will avert any sharp rises.

Vice president of gasoline pump manufacturer said he was not worried. "The country got along for 160 years without OPA. Competition will straighten things out," he stated. He declared his company planned no change in prices of pumps now. Later, he added, there may be some price increases, but competition will "level them off."

Vice president of another gasoline pump company told NPN:

"If the pump industry goes off half-cocked because of the death of OPA, the industry will get regulations from Washington more stringent than OPA. This applies to all industries. Conversely, if the industry will use common sense in its actions and take a cooling off period for the next 30 to 60 days, conditions will improve.

"Manufacturers have been telling labor to take time to cool off when an emergency arises. Now they should follow this advice and cool off before taking any drastic action on prices. Even if they have been losing money for a period, 30 days more won't make or break the industry. Failure to do so may place the industry in worse shape than ever before."

One tire producer expressed the opinion that he felt prices in this market would remain stable. He said the law of supply and demand will steady the market.

He added that while there still are some shortages in the industry, the overall situation is very satisfactory now.

The tire man concluded by saying, "It's up to industry to prove that OPA is not necessary and that a free system of enterprise is the American way of doing business for the best of all concerned."

No Authority to Pay Subsidies On Stripper Wells, Says RFC

NPN News Bureau

WASHINGTON—RFC said July 1 it had no authority to pay stripper well subsidies in absence of price control legislation, and doubted that operators could be paid for time no law was effective unless Congress makes provision for retroactive payments.

Agency pointed out that subsidies were hinged on OPA ceiling prices, and there would be no basis for paying them until law is enacted. Notices that program has been terminated by failure to pass extension measure are being prepared, and will be sent in next day or two.

Oil Does Its Part as Industry Explodes Reformers' Inflation Bogy

The great falsity of the statements which Truman, Bowles, OPAers and the rest of the radical reformers at Washington have been issuing of late, that industry prices would "inflate" on death of OPA, is about to be demonstrated most definitely it now seems.

In two days of no OPA there is no skyrocketing of prices in any industry nor even any increases at all in practically all industries. High prices are being bid for the few meat animals that have started back to market, following the OPA's meat shortage, but every indication is that we will soon have a lot of meat and at less than the open market—the black market prices. There are increases in rents, and in some cases great increases, but renting homes and most buildings is not an industry. Individuals mostly those without business experience, seem to be the ones doing the rent raising.

Prices in the oil industry have barely changed and then not to old OPA ceilings. In the tank car markets are a few usual seasonal adjustments, some gasolines up and some down. A much needed crude advance, not yet forecast by crude buyers, would of course send up most all prices but as that advance will undoubtedly be less than a penny a gallon on crude, it will reach the public mostly in fragments of a cent. However any such crude oil advance will save the taxpayer the cost of paying up to 75c a barrel subsidy on crude from stripper wells.

The oil industry has not been attacked as unjustly in the past several weeks by the New Dealers as have other industries and it may be because of the long steady price record of the industry. During World War I, when there was no OPA, the oil industry pegged prices at reasonable levels, approved by government, and held them there. Some brokers and small refiners ran the price of heavy fuel oil up but those sales were but a small fraction of the industry's total sales. The industry's price policy has been conservative. A good bit of the time the prices have been lower than they should have been. From the first world war to this last one, the oil industry's price policy is best illustrated by the steady decline in the price of gasoline, a decline of more than 75% and a decline that, to a considerable extent, has been seized on by federal, state and local governments to collect as taxes.

It is well that OPA has been abolished. May it never return. However Congress probably should place some controls on ESSENTIAL products that are still highly scarce. If that is necessary maybe Congress can recreate a control organization in such a way as to eliminate some of the bad personnel and gross mismanagement of OPA.

OPA has seldom been fair, law abiding or mindful of the needs of this country and its citizens. OPA personnel has been largely of a radical, reform even downright un-American type. A lot of them never paid any attention to the truth nor the lawful rights of the citizens. OPA dominated this country's economy to the serious detriment of our war effort. OPA put a price level that was aimed at reducing profits and thus hamstringing business, ahead of the needs of the prosecution of the war.

OPA was supposed to confine its regulatory efforts to the necessities of our daily living. While the citizens were engrossed in fighting the war the OPA radicals extended their totalitarian hands out to tens of thousands of articles, far removed from our essentials of life. We are just learning of how widely they grabbed for control of all business by the releases OPA is now issuing.

How could the prices of hair pins, piano benches, lube oil additives, heat tablets for campfires, smokers lighting fluids, shock absorber oils and other such minute specialities affect our cost of living? If the OPAers had confined their efforts to those things which constitute our real cost of living and kept their heavy hands off all else, they could have operated with a small percent of their enormous staff, they could have done a far better job on those few necessities and they would not have proved to the American people that they were chiefly interested in seizing control over our daily lives.

Every policy of the Roosevelt and Truman administrations shows that OPA aimed at more and more control of our daily living rather than at winning the war and leaving us a free people, a people whose government worked for them rather than a people who worked for the government and its bureaucrats.

Truman, in his tricky maneuvers of the last few days particularly when he double crossed his own Democratic Congressional leaders, clearly shows that he is far more interested in obeying the CIO and other union bosses and more concerned with bringing about the CIO aims for complete government control over all our business and private lives, than he is in carrying out the principles on which this country has grown great.

American industry, owned by the American people, at last now has an opportunity and it is taking full advantage of that opportunity, to prove to the public what a lot of mudslingers and liars there are who have been trying to seize their government.

And the oil industry is doing its part in offering that proof. W.C.P.

Oil Decontrol Begun Before Law Expired

NPN News Bureau

WASHINGTON—First step in oil decontrol program was taken by OPA June 28, before expiration of price control law, when ceilings on 22 petroleum products of minor importance were suspended, effective as of June 28. Action, taken in SO 166, was to apply when products contain 50% or more petroleum.

Items decontrolled were:

Stick type lubricants for automobile and household use; solid heat tablets for campfires, fireplace, kindling, etc.; spot removers, dry cleaners, rug and upholstering cleaners in containers of five gallons or less, smokers' lighter fluids; hydraulic brake fluid; knee action oil; shock absorber oil; hydraulic jack oil.

Penetrating oil; upper cylinder lubricants; motor tune up products; lubricating oil in containers of one pint or less; preservative oils and compound for metal, leather, etc., in containers of one gallon or less; floor oils; household insecticides and household disinfectants.

Hydraulic hoist oil; grinding and cutting compounds in containers of one gallon or less; additives for improving or modifying lubrication oil, or grease properties such as pour depressants, viscosity index improvers, oxidation inhibitors, detergent additives, extreme pressure agents, tackiness additives, etc.; napthenic acids; metallic napthenates; natural and synthetic mineral oil polymers; calcined petroleum coke.

Delay Tire Distribution Bill

WASHINGTON—Vote on bill (S. 718) to channel distribution of all tires through independent dealers was delayed at NPN press time by Senate Banking and Currency Committee after several members protested they had not had time to review hearings on matter conducted by previous Congresses.

Peckham Is Air Quartermaster

WASHINGTON—Brig. Gen. H. L. Peckham, Director of Procurement, OQMG, and former director of Fuels and Lubricants Division, OQMG, has been reassigned to duties as Air Quartermaster, AAF. In this post, he will serve under Maj. Gen. E. M. Powers, AAF member of A-NPB.

Here's Why Jobbers Can't Get Enough Pennsylvania Grade Oil

Production Decline, Purchase of Producing Leases By Refiners Reduces Amount of Free Oil Available

By Holger Ridder
NPN Staff Writer

PITTSBURGH—What has happened to the Pennsylvania grade crude and motor oil supply?

This question, asked with increasing frequency in letters addressed to the Pennsylvania Grade Crude Oil Assn., can only be answered by an overall perusal of the entire Pennsylvania grade picture for about the last four years.

Several factors are contributing to the current tight supply of Penn-grade oils. Primarily they are:

1—Decline in production of Pennsylvania crude (see chart below, table on p. 15).

2—Heavy wartime demand which practically depleted reserve crude stocks above ground.

3—Present practice of refiners in building up inventories for their branded oils.

4—Refinery purchases of producing leases.

5—Heavy rise in postwar demand for Penn-grade oils.

Though not in session for the express purpose of answering the supply queries of jobbers and marketers, members of the Pennsylvania Grade Crude Oil Assn. heard speakers give their 22nd annual convention, held here last week, a pretty complete production picture and explain the extensive research program now underway to increase output in the Pennsylvania fields.

W. C. Wenzel, executive manager of Pennsylvania Grade Crude Oil Assn., said in an interview before the meeting that there is nothing mysterious about the current Penn-grade supply shortage. While underground reserves are adequate, the amount of crude available above ground, due to various contributing circumstances, just isn't sufficient to meet demands.

Generally the Penn-grade crude picture stacks up something like this:

Decline in production — Association figures show Pennsylvania grade crude production reached a peak for recent years in 1942 when 28 million bbls. (about 76,712 b/d) were produced. At present production is averaging about 57,000 b/d, a drop of between 19,000 and 20,000 b/d.

Average production of wells in Penn-grade region ranges from ½ to 3 or 4 b/d with a few in the Warren-Bradford area reported producing as high as 9 b/d. But output of above 5 b/d is the exception rather than the rule. During the wartime peak output this average was slightly higher, but not sufficient to meet entirely the huge increase in demand, thus making it necessary to draw on above-ground stocks.

Above-ground reserve stocks—During the war, from December, 1941, through August, 1945, Penn-grade refineries turned out an estimated 23,964,036 bbls. of lubricants, or 15.8% of the total U. S. output of lubricants in that period. Though less than 2% of U. S. crude production in the first six months of 1943 was Pennsylvania, the Pennsylvania grade region, in that same period, provided 44%, or nearly half, the entire aircraft oil requirements for U. S. and Lend-Lease, domestic airlines and airplane engine manufacturers.

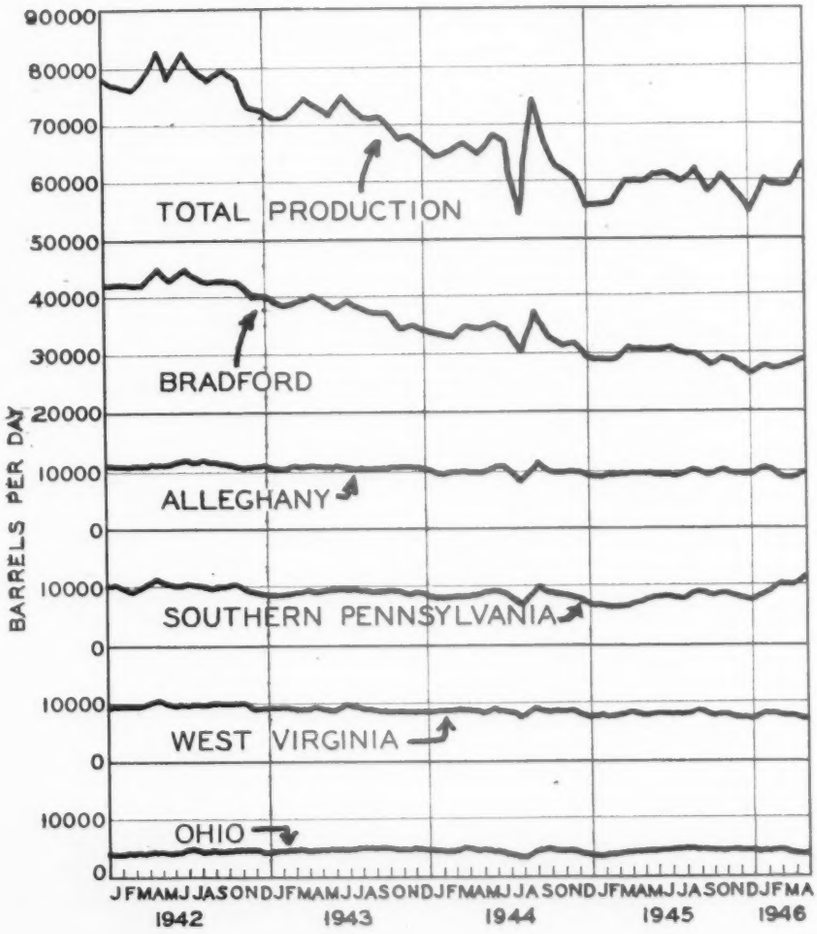
In order to meet this demand, production was carried on at a peak rate and above-ground reserve stocks of crude were practically depleted. At the close of 1945 Bureau of Mines figures showed Penn-grade crude stocks at 1,923,000 bbls. About 10 years ago Penn stocks were around 4,500,000 bbls.

Refinery purchases of producing leases—During the war period some refineries began purchasing producing properties in order to assure themselves of a supply for their branded product. Penn-grade production began dropping in 1942 and these refiners acted to assure themselves of a postwar supply. Thus, when the war ended, the amount of free production available to supply unbranded oils to marketers and jobbers for use as their own branded oil was narrowed considerably.

Building up inventories—Cutting the marketer's and jobber's supply source even thinner has been the effort of refiners to build up their inventories of crude depleted by wartime demands. Crude stocks as of June 1, 1946, were 2,427,000 bbls., according to the Bureau of Mines, indicating a rather sharp rise from the December, 1945, figure given earlier.

Heavy postwar demand—Another big drain on Penn-grade supplies has been the greatly increased postwar demand for refinery branded Penn-grade oils. Refiners of branded products found that, despite their purchase of additional crude oil leases, it is difficult to keep

Pennsylvania Grade Production from Jan. 1, 1942 to May 1, 1946



pace with market needs of their own branded oils.

Mr. Wenzel explained the current heavy postwar call for Penn-grade oil by the motorist in this way. Most motorists are driving old cars and they want to keep them running. Where before the war many were content to buy any grade of oil, today they have the money; they are anxious to keep their cars running as long as possible, so they buy the more expensive grade of oil.

A West Coast oil man at the convention said one California company reported its sale of Penn-grade oil this year up about 50% above its best wartime year.

Thus, the refinery unbranded output which, prewar, supplied the marketer and jobber with most of his Penn-grade oil, has shrunk to the point where many independent buyers find they just can't get enough to meet their demand.

Mr. Wenzel declared that rumors about substantial Penn-grade exports are without foundation. Some bright stocks occasionally may be finding their way into export channels but very little if any neutral is going out.

The Future of Production

But what about future Pennsylvania production? The answer seems to lie in three factors:

1—Research to develop and improve methods of recovery.

2—Exploration and development of new fields, such as Music Mountain south of Bradford, Pa.

3—Encouragement of marginal operations and extension of present fields into the marginal areas.

As to new fields in the Appalachian area, association members here say there is some wildcatting going on but it is too early to judge its future importance.

The question of marginal operations is largely one of economics. Though slight, there are occasions where operators in established fields are not developing the marginal areas of the field because the margin of profit is so small due to low output per well and the costs so high that they would profit little or not at all by so doing. Economically they are in a better position if they merely continue operating already established and good producing wells.

Urges Unitization Plan

W. A. Heath, supervisory engineer, Phillips Petroleum Co., Bartlesville, Okla., touching on one phase of production, addressed the convention on "Unitization of Oil Pools for Secondary Recovery Development."

He said land maps in the Penn-grade region resemble jig-saw puzzles because lease boundary lines are so irregular. Property lines interfere with efficient development, he asserted, and urged an educational campaign to acquaint oil operators with advantages of centralized operation of oil lands held under diversified ownership.

"Only by unified effort will the maximum recovery and profit be realized," he said.

Percentage Decline Over Previous Year From 1943-1945

	1943 43 over 42	1944 44 over 43	1945 45 over 44
	Per cent		
Pa. Grade Area	8.9	9.8	7.7
Bradford Field	11.4	11.4	11.0
Allegany	5.3	4.9	3.1
S. Penna.	8.8	9.3	5.6
West Virginia	7.3	8.7	5.8
Ohio	+4.8	11.0	+.003

Large scale unitization of old fields with small wells started 20 years ago in Nowata County, Okla., he explained. Production of crude oil from 11 projects in Greenwood County, Kan., currently would amount to 650 b/d if unitization had not been introduced there 10 years ago. Now, he said, actual production totals 4800 b/d.

Describe Research Work

Richard V. Hughes of Bradford, director of production research for the association, summarized the studies and association laboratory staff members described results to date at morning sessions June 27.

H. C. Lawton, research associate, said selective plugging agents, such as silica-gel-forming solutions and urea-formaldehyde resin-forming soultions, can be used in water, oil and gas wells throughout the four-state Penn-grade region to control excessive flow of water into cable tool drilling wells; to seal off thief sands in water and gas input wells, and to control water-oil and oil-gas ratios in producing wells.

Considerable plugging of the sand face of input wells has been traced to bacteria, according to J. V. Beck, association microbiologist. He said studies will be made of bacteria's part in pipeline and well tubing corrosion and activities of specific bacterial cultures in removal of paraffin from producing wells and oil lines.

Use of hydrochloric and hydrofluoric acids has aided oil production in nine experiments in the Bradford field, according to R. J. Pfister, head of the association laboratory. The acids were used in water input wells to clean the sand face and open up sands having low water intake rates. He said all but one of the nine wells have shown increases in intake rates from 50 to 300%. Preliminary data on oil production indicate favorable results are being obtained.

Speaking at the luncheon session June 27, G. H. Sheldon, New York advertising executive, cited the association's 22-year advertising record on behalf of Penn-

Officers, Directors of Pennsylvania Grade Crude Oil Assn.

Special to NPN

PITTSBURGH — Officers elected June 28 at 22nd annual convention of Pennsylvania Grade Crude Oil Assn. are:

President—D. T. Ring, Columbia Oil & Gasoline Corp., Columbus, O.; first vice president—B. T. Haskins, Ebenezer Oil Co., Wellsville, N. Y.; second vice president—George J. Hanks, South Penn Oil Co., Bradford, Pa.; treasurer—Samuel Messer, Quaker State Oil Refining Corp., Oil City, Pa.; assistant treasurer—W. R. Reitz, Quaker State, Oil City; assistant treasurer—C. L. Suhr, Pennzoil Co., Oil City; vice president and general counsel—Fayette B. Dow, Washington; executive manager—W. C. Wenzel, Oil City.

New directors elected to the board are: A. L. Bailey, Canfield Oil Co., Cleveland; K. C. Baker, J. D. Streett Co., St. Louis; James D. Berry, Jr., James B. Berry Sons & Co., Oil City; C. A. Chipman, Bolivar, N. Y.; Hugh A. Grant, Grant & Mahan Oil Co., Bradford, Pa.; Leonard Eberl, Messer Oil Corp., Olean, N. Y.; C. J. Leroux, Freedom-Valvoline Oil Co., Freedom, Pa.; C. M. Oliver, Bradford District, Pennsylvania Oil Producers Assn., Bradford; James Taylor, W. H. Barber Co., Chicago.

Re-elected to the board of directors were:

D. T. Andrus, Andrus, Lent and Daggett Co.; A. E. Booth, M. D. Booth and Co.; J. B. Fisher, Kendall Refining Co; Mr. Hanks, South Penn.; A. C. Simmons, Simmons Oil Corp.; E. F. Smith, Smith-Newton Oil Co.; C. E. Streeter, and R. T. Zook, Sloan and Zook Co., all of Bradford.

E. C. Breene; W. J. Brundred, Brundred Oil Corp.; Mr. Messer, Quaker State; A. W. Scott, Wolf's Head Oil Refining Co., and Mr. Suhr, all of Oil City, Pa.

F. G. Bannerot, Jr., Elk Refining Co., Charleston, W. Va.; P. R. Beck, Pennsylvania Refining Co., Butler, Pa.; W. F. Clinger, Superior Oil Works, and H. A. Logan, United Refining Co., Warren, Pa.; Mr. Dow; P. N. Faine, Ohio Pennsylvania Grade Crude Oil Assn., New Straitsville, O.

Otto W. Walchli, Richardson Petroleum Corp.; Mr. Haskins, Ebenezer Oil and G. W. Holbrook, Bradley Producing Corp., all of Wellsville, N. Y.; D. E. Hoffman, Tide Water Associated Oil Co., and R. G. Sonneborn, L. Sonneborn Sons, Inc., New York City; C. C. Hogg, Marietta, O.; Howard T. King, South Penn Natural Gas Co., Parkersburg, W. Va.

D. B. McCalmont, Franklin, Pa.; W. K. Page, Olean, N. Y.; R. J. Purkins, Wm. C. Robinson Sons Co., Baltimore, Md.; Mr. Ring; and S. M. Vockel, Waverly Oil Works Co., Pittsburgh.

grade oils. Among other things, he said, "No step you could take would please your competitors as much as a voluntary decision on your part to emasculate the aggressive united front you have maintained against all other oils."

Presiding at the luncheon session was F. B. Dow of Washington, association vice president and general counsel.

Principle speaker at the dinner was E. W. Yorke, Jr., of DuBois, Pa., former member of the U. S. military mission to Moscow, who gave an off-the-record talk on Russia. D. T. Ring of Columbus, new association president, presided.

Teamster Union Drives To Organize Operators

Special to NPN

JOLIET, ILL. — Heavy pressure to unionize service station owners and dealers here and in nearby towns is being exerted by Local 179, International Brotherhood of Teamsters.

Current activity in this area, long a union stronghold, is successful because operators fear that their supplies will be shut off with union truck drivers refusing to deliver to them.

Among operators who have refused to join union are Leo J. Dinoffria, a Navy veteran of World War II, and John Clementi. Dinoffria already has been forced to close his station, which he had reopened only last March following his discharge from the Navy. He was a Standard Oil (Indiana) dealer.

Clementi's station is still open. He is hauling his gasoline in a makeshift tank truck from an independent refinery outlet. He previously purchased from The Texas Co.

Sued Union for Damages

Dinoffria and Clementi sued the union, claiming damage to their property, but lost in lower court. Their appeal to the Illinois Appellate Court is expected to be heard in October.

In nearby Plainfield, Ferdinand Klomhaus and his sister, Ella, operators of separate stations, have also resisted union efforts. Both have reported receiving an ultimatum by the union "to make up their minds."

Ferdinand Klomhaus states that the matter is not a labor dispute. "I have nothing against any employe joining the union," he said, "I think it is a good thing, but they have no right to force owners or operators into a union."

Union Representative Virgil Floyd told NATIONAL PETROLEUM NEWS the Klomhaus stations were the only two out of eight dealers in Plainfield, who have refused to pay union initiation fees of $10. "Monthly dues," he said, "are $5 for the first month of each year and $4 for the other 11 months. The extra dollar once a year," he said, "is for defraying additional annual bookkeeping costs."

New England OHI Gets 2 Versions on Burner Service Charge Issue

By NPN Staff Writer

BOSTON—The question of whether to collect for oil burner service through "hidden" charges or by a separate service charge remained unsettled last week among members of Oil Heat Institute of New England. Opinion, at least that of two Institute speakers, was split, with one advocating an increase of 0.5c per gal. to the price of fuel oil to cover burner service, and the other favoring a separate charge for service, "billed as rendered."

Paul Ryan, addressing the annual exposition of the Institute at Statler Hotel here, told members he approved of the "hidden charge" policy, already reported in use in Fall River, Mass. He told fuel oil marketers, burner and accessory manufacturers and dealers that he felt the 0.5c extra per gallon to cover service was justified.

Mr. Ryan pointed out that customers seldom knew the exact price they were paying for fuel, which proved to him they were not so much interested in price as they were in continuous, fully automatic heating service.

On the other hand, he pointed out, bills for service are much more likely to disturb a customer, because he cannot know in advance the amount and frequency of the charges. These arguments met with a strong rebuttal in the course of a later address by Walter F. Rockwell, president of the Timken-Detroit Axle Co.

"I believe the public is tired of hidden charges," said Mr. Rockwell, asserting that a separate charge for service, billed as rendered, would be much fairer to the customer. However, he concurred with the view that fuel oil dealers should charge enough to provide proper service.

Fuel oil men should make enough profit, Mr. Rockwell said, so that they could afford to pay good salesmen, and to hire skilled mechanics to properly install the burners and to take care of them after the installation is made. The responsibility is on the dealer to see that honest selling and good installations produce satisfied customers.

Urges Installment Selling

Fuel oil dealers who sell burners should get ready for installment selling, Mr. Rockwell said, pointing out that people could not buy all of the things they wanted out of accumulated savings. He warned about market surveys in all appliance lines, each of which showed equally large consumer demand. They reflect the average American's optimistic viewpoint. When questioned he will readily express a desire for a long list of items, but does not mean to imply he has the cash on hand to pay for all of them.

Dealers who sell oil burners should be ready for the time when the consumer has used up his savings on the first available purchases. They can help him buy one or two more items on his "want list" through the use of credit and installment payments.

Bankers have come to share with the national installment finance organizations the opinion that oil burner "paper" is safe, and that few people can be persuaded to give up a good oil burner which is properly installed. Houses increase in resale value for more than the installation cost when a good oil burner goes in.

Relations between oil burner dealers and their salesmen must be improved, Mr. Rockwell went on, and it should start with the selection of the salesman by the dealer. Personnel management has made great progress in the last several years, and alert manufacturers and dealers could take full advantage of the scientific tests to pick the proper man for the job.

Prospective salesmen should be tested for the right personality, the necessary mental equipment, and for the buoyant optimism that is so important a part of good sales personality. It is old fashioned to believe personal judgment in hiring men is the best guide. It has been proved that scientific selection pays and that, when this method is used, proper training and supervision will then develop a superior salesman who can lick ordinary competition to a standstill.

"Also keep in mind that no wage is too high that is earned," Mr. Rockwell said. "Make it possible for your salesmen to earn more by following your instructions. Careful supervision of a sales force is one of the dealer's most important functions."

There is no question, he added, that the oil burner salesman's income should be increased and stabilized. Three aids were suggested:

1. Use of live demonstrator on the burner dealer's display floor, to attract more prospects,
2. Advertising to develop inquiries.
3. Continual contact with satisfied users, as an additional source of prospects.

It is the oil burner manufacturer's problem, Mr. Rockwell pointed out, to set up dealer territories so that maximum volume can be obtained. Without the volume, low costs cannot be maintained, so the manufacturer is dependent upon a concentrated job of selling.

Burner Shipments Up 14%

WASHINGTON — Factory shipments of oil burners totaled 34,943 during April, 14% more than March in shipments. During the first four months of 1946, 121,932 burners were shipped as compared with 37,623 for 1945 and 23,769 for 1944.

Bureau of Mines Predicts Continued High Demand During 3rd Quarter, Increased Fuel Oil Markets

NPN News Bureau

WASHINGTON—Refinery operations and third quarter demand for crude probably will continue at same high level as in second quarter, Bureau of Mines predicted July 2.

Outlook was based on "the assumption of a larger supply and market for fuel oils than was anticipated in forecast for 1946." (See NPN June 5, p. 7, for 1946 forecast of demand).

Bureau estimates crude oil demand in July will be 4,748,000 b/d, an increase of 78,000 b/d over forecasted demand during June.

In summing up current situation, Bureau said actual demand for domestic crude was 4,608,000 b/d in March while estimated demand was 4,670,000 b/d in April and 4,790,000 b/d in May with indicated continuance of latter rate in June.

Finished gasoline stocks, bureau stated, increased 5.8 million bbls. in first quarter but may have been reduced at least 12 million bbls. during second quarter.

"Total demand for motor fuel amounted to 171.4 million bbls. in first quarter and may be about 202 million bbls. in second quarter, or 1% above total estimated in June forecast," it was said. "Exports in second quarter probably will be substantially lower than anticipated and civilian demand correspondingly higher."

During second quarter crude runs to stills are estimated to have totaled 4,760,000 b/d, up 151,000 b/d from first quarter. Bureau explained increased runs has resulted "primarily in larger production of fuel oils than was anticipated."

Demand for light fuel oils in second quarter is estimated at about 62 million bbls., an increase over first quarter demand which "may reflect advance seasonal buying by distributors and consumers as well as a gain in actual consumption over previous estimates."

Second quarter demand for residual fuel oils, Bureau continued, may have been about 2 million bbls. less than estimated. Stock increases may reach 10 million bbls.

Table shows Bureau's forecast of July crude demand on each producing state, compared with forecast for June.

July Crude Demand Forecast
(Daily averages in bbls.)

State	Forecast July 1946	Forecast June 1946
Texas	2,110,000	2,050,000
California	844,000	848,000
Oklahoma	384,000	380,000
Louisiana	380,000	380,000
Kansas	260,000	255,000
Illinois	210,000	210,000
Wyoming	112,000	104,000
New Mexico	97,000	98,000
Arkansas	78,000	79,000
Mississippi	60,000	57,000
Michigan	47,000	46,000
Pennsylvania	34,000	34,000
Kentucky	31,000	31,000
Colorado	28,000	26,000
Montana	22,000	22,000
Indiana	19,000	18,000
New York	14,000	14,200
West Virginia	8,400	8,400
Ohio	7,600	7,600
Nebraska	800	800
Other	1,200	1,000
Total U. S.	4,748,000	4,670,000

Set Louisiana Allowable

NPN News Bureau

BATON ROUGE—Louisiana Department of Conservation has set total crude allowable for July at 428,641 b/d, over June figure by 10,827 bbls.

Revised Leasing Bill Now Up to House With Passage Seen

NPN News Bureau

WASHINGTON—Revised oil and gas leasing bill (S. 1236) which met most of Interior department's objections to O'Mahoney-Hatch measure passed by Senate was placed on House calendar this week, with passage by House regarded as certain.

Changes were incorporated into bill by House Public Lands Committee after Secretary of Interior Krug, in strongly-worded letter to committee, charged that certain new provisions had been added by Senate—"apparently at the request of representatives of the oil industry" — which were "obviously designed to benefit special interests."

Secretary Krug said these provisions "impose administrative tasks of such magnitude as to make administration of the bill difficult and costly," and set forth five "major" objections.

Agreed on Amendments

As a result of Interior's protests, and with threat of veto imminent, House group agreed upon these amendments:

1. Excluded from scope of bill those lands transferred to Interior department by executive order for Indian use.

2. Limited flat 12½% royalty to lease on which new discovery is made, or which is included in any unit or co-operative agreement approved prior to discovery.

3. Gave Secretary of Interior discretion to determine limits of producing oil or gas deposit.

4. Provided that proportionate interest of each tenant in common on lease shall be charged against total acreage any one individual may hold.

5. Provided assignor of lease and his surety shall continue to be responsible until Secretary of Interior approves assignment, and allowed secretary to disapprove any lease or part of legal subdivision, while limiting grounds on which he may reject proposed assignment of lease.

Secretary Krug said sections of bill amending royalty provisions of Mineral Leasing Law would have effect of reducing royalty rates of lands included in producing leases as well as semi-proved land within known geologic structure to flat 12½%, and called this "indefensible and unjustifiable from every point of view."

Provisions for flat royalty rate on all future non-competitive leases issued for lands not within known geologic structure of producing field was attacked on ground that "only those lessees who discover or contribute to discovery of a new field or deposit" should be entitled to the flat royalty.

Interior boss said provision for assignment of leases without prior approval and limitation of grounds on which they may be disapproved was "incompatible with proper protection of interests of the government," while provision allowing individuals to lease up to 15,360 acres in a single state would permit circumvention of acreage limitations by allowing individuals to join together as tenants in common and lease far more than 15,360 acres among themselves.

Final point raised by Secretary Krug was that making lands transferred for Indian use subject to disposition under Mineral Leasing Law "fails to take cognizance of rights of Indians who are affected thereby."

House Bill Gives Small Refiners Preference in Buying Royalty Oil

NPN News Bureau

WASHINGTON—House July 2 passed bill (S. 680) granting small refiners preference in purchase of government royalty oil. Measure now goes back to Senate, as result of three minor amendments incorporated into bill by House Public Lands Committee.

House Votes Additional $255,000 Fund for FTC Reorganization

NPN News Bureau

WASHINGTON — The House has voted an additional $255,000 appropriation to FTC for expenditure on a reorganization program which contemplates, among other things, the setting up of fair trade practice rules for oil and other industries (see NPN June 19, p. 22).

Item is still subject to Senate action and is $602,000 less than had been recommended for FTC by Budget Bureau.

In proposing that agency be allowed only a portion of funds sought, House Appropriations Committee had said aims of FTC program were laudable, but that it was "not satisfied that much of them are not possible of attainment by differently utilizing present personnel." Pointing out that added personnel requirements must be largely conjectural, it said the needs fully to effectuate new practices proposed cannot be definitely foretold.

Hope for more liberal support in light of actual experience was held out by committee, which asserted that reduced amount it is proposing "bespeaks sympathetic attitude toward proposed program and should enable an effectual feel-your-way approach."

DETROIT PUBLIC LIBRARY

'Gas' Industry Faces No Lead Curtailment In July Production

NPN News Bureau

WASHINGTON—The nation's refiners have been assured by CPA that July production of leaded gasoline can continue at permitted June levels.

CPA said no changes will be made in L-555 during July, and probably not during succeeding two months of the third quarter, and that sufficient metallic lead—4,000 tons—has been allocated for production of Ethyl fluid to meet maximum permitted usage under the tetraethyl control order. Allocation is 200-tons less than the June quota.

While the gasoline industry thus faces no cutback in operations, other lead users, who are on a quarterly quota basis, face allocation slashes all across the board during July, August and September. Battery manufacturers, for one, were reduced to 57,000-tons from the 66,000-tons permitted in the second quarter.

The 9,000-ton reduction for batteries was accomplished by a new use-formula in M-36, metallic lead allocation order, which authorizes manufacturers to use only 19% of total 1944 consumption, instead of 22% permitted in second quarter.

Third quarter metallic lead allocations for all purposes total 217,000 tons, compared with 232,000 in second quarter and 257,000 in first quarter.

To help spread proportionately the thin supply of lead, CPA also ordered primary lead producers, beginning Aug. 1, to set aside 25% of output to build up government stockpile., Metal Reserves Corp. will sell set-aside lead to authorized users holding CPA purchase certificates.

Object of this move, CPA stated, is to prevent some users from gobbling up available supply, thus shutting out small users. CPA purchase certificates are issued only when permitted users are unable to make purchases on open market.

Summary of NLRB Reports Affecting Oil Companies

NPN News Bureau

WASHINGTON—Recent developments in NLRB cases involving oil and related companies have been reported by the agency as follows:

Certification

Gulf Refining Co. (Case 9-R-2034), Cincinnati, O., sales district. Election held June 4. Certified for all service station attendants of company's Cincinnati sales district, including managers, assistant managers, service station salesmen and saleswomen and washers, but excluding all supervisory employes): Petroleum Haulers, Garage, Station and Parking Attendants, Local 103, AFL, which received 56 out of 57 valid votes cast.

The Atlantic Refining Co. (Case 16-R-1527), Tulsa, Okla. Election conducted by mail. Certified (for production and maintenance employes) OWIU-CIO, Local 209, which received 18 out of 34 valid votes cast; 14 votes were cast for independent union, 2 for neither.

Dismissal of Petition

Ethyl Corp. (Case 15-R-1501), Baton Rouge, La. June 21 board dismisses petition for investigation and certification of representatives filed by Int'l. Chemical Wkrs. Union, AFL, following May 31 election in which 44 out of 119 valid votes cast were in favor of the union; 75 votes were cast against.

Denial of Motion

Continental Pipe Line Co. (Case 16-C-1219), Ponca City, Okla. Board denies motion by company to reopen case for purpose of receiving further evidence purported to show that James M. Pumpelly resigned and was not discriminatorily discharged because of activities in Int'l. Union of Opr'g. Engs., Local 550, AFL, as Board had found.

Non-Housing Construction Totals $290 Million in May

NPN News Bureau

WASHINGTON—Non-residential construction during May increased to $290 million from $261 million in April, despite CPA efforts during past month to curb approval of application for non-housing projects.

Report was made in monthly CPA summary of industrial activity. Agency said highway and other public construction continues to improve and is now approximately 100% above what it was a year ago.

C. M. Gile Elected Marketing Vice President of Gulf Oil

Clement M. Gile, new vice president of Gulf in charge of marketing

Special to NPN

PITTSBURGH — Clement M. Gile, who has been associated with Gulf Oil Corp. for 20 years, this week was elected vice president in charge of marketing, succeeding W. V. Hartman, retired. Mr. Gile will also be a vice president of Gulf Refining Co. and vice president and a director of Gulf Research and Development Co.

Mr. Gile entered the oil business with the New England Oil Co. in 1920. He joined Gulf in January, 1926, as assistant to the general manager of sales. In 1933 he was made general manager of refined oil sales.

During World War I Mr. Gile was in the submarine service as an ensign. His three sons saw active military duty in World War II.

Agreement Signed; Pure Oil Co. Workers Return to Their Jobs

Special to NPN

TOLEDO—All workers were back on the job July 2 at Pure Oil Co.'s refinery here and at Cabin Creek, W. Va., plant following signing of an agreement June 29 by Pure Oil and OWIU officials.

Local plant was closed six weeks ago when maintenance employes walked out in dispute over company charges of abuses of privileges. Cabin Creek refinery shut down when two men, said to be members of OWIU here, picketed the plant there, although there was no dispute at that plant.

Agreement was signed by David S. Frank, refinery superintendent, and Kenneth Koch, chairman of Pure Oil's plant group of OWIU Local 346 (CIO).

Only a few minor points are still to be settled. Both sides agreed to talk these over in the next 30 days.

Appeal in Power Oil Case By WHA Is Seen Probable

WASHINGTON—Appeal by Wage-Hour Administration from recent decision by Federal District Court at Charlotte, S. C., which dismissed complaint against Fred W. and Florence E. Herlihy, doing business as Power Oil Co., Orangeburg, S. C., appeared probability this week. (See other story on p. 44.)

Decision, WHA believes, was equivalent to holding that employes handling records and goods going through company's warehouse to retailers in vicinity were not engaged in interstate commerce. Allegation that Power Oil Co., is wholesaler and thus not exempt as retailer under fair labor standards act was implicit in complaint.

Measurement Is Accurate

On page 28 of the May 29 issue in describing the automatitc stop valve and automatic meter device used at the Standard Oil (Ind.) pipeline terminal at Council Bluffs the statement that the valve cuts off the stream mechanically "within a 9-gallon tolerance" was misleading. Actually the measurement is right on the button. What does happen is that the meter operates at full capacity to a point 9 gallons before the end of the run and the valve slowly closes through the remaining 9 gallons to shut off without shock and to prevent agitation of the liquid in the tank from overflowing the dome.

CORRECTION

Because incorrect information was supplied to National Petroleum News, the identification lines for the Virginia Oil Men's Assn. photographs on page 15 of the June 26 issue were reversed. The type identifying the photograph at the top should have appeared with the photograph at the bottom of the page and vice versa.

Harvard Report Shows Marketing Research Value, Morrill Says

Special to NPN

BOSTON—Clyde G. Morrill, executive secretary of the Atlantic Coast Oil Conference which was one of the sponsors of the Harvard report on "Retail Marketing of Furnace Oil" (see NPN, June 26 p. 16), sees the report as pointing up the need for further research in petroleum marketing.

The report was prepared by Prof. Harvey P. Bishop of Harvard's Graduate School of Business Administration.

"It is always valuable," Mr. Morrill says, "for an industry to have a competent observer who has no previous knowledge of the industry to put down his ideas and his thoughts when an opportunity is made possible. This report is such an instance.

"A careful reading of it will indicate a good many avenues that should be explored in the near future. This research has shown how it can be done co-operatively by large and small companies working together.

Mr. Morrill also praised the brevity of the report, contrasting it with wordy studies that have come from Washington. There is, he says, no "gobbledegook" in it.

That the Harvard study will influence policies in marketing of furnace oil is certain, Mr. Morrill added.

Truman Says Parten Won't Take Full Employment Appointment

NPN News Bureau

WASHINGTON — President Truman last week said that J. R. Parten, Houston, Tex., oil man and former PAW transportation director, is unwilling to accept appointment as head of three-member council of economic advisers under Full Employment Act.

Chief executive used Mr. Parten as example of what he meant in telling press conference that government salaries are too low to attract competent administrators. Job he wanted Mr. Parten for would pay $15,000 annually.

Posts Same Tank Wagon Prices For Divided, Undivided Dealers

Special to NPN

PHILADELPHIA—Both divided and undivided dealers now pay Atlantic Refining Co. the same price for tank wagon deliveries of gasoline under a revised price schedule posted by the company on July 1.

Effective that date, Atlantic discontinued the 0.5c differential which it had been posting between divided and undivided dealer prices in all areas where it markets except Georgia and Florida, with divided dealer prices dropping to the undivided dealer level. (See page 53 for new prices). The company's prices have been the same to both classes of accounts in Georgia and Florida for some time past.

Just prior to elimination of the 0.5c differential between divided and undivided dealer prices, Atlantic advanced its divided dealer postings 0.3c per gal. at three eastern Pennsylvania and two Delaware points. Divided dealer prices, ex taxes, posted June 26 follow: Philadelphia, Pa. and Wilmington, Del., 9.5c; Allentown and Harrisburg, Pa., 9.8c; Dover, Del., 10c. Atlantic's July 1 postings at these points, applying to both divided and undivided dealers, are 0.5c less.

Death Ends Taylor's 20 Years Of Service with Ethyl

NPN News Bureau

NEW YORK—J. Coard Taylor, 45, vice president in charge of sales of Ethyl Corp., whose death occurred June 25, had been associated with the company for 20 years. He began his Ethyl career as Canadian representative, later as assistant sales manager and general sales manager. He had been a vice president since 1937.

Mr. Taylor

Mr. Taylor entered the oil industry in 1923 with the Standard Oil Co. (N. J.) as a student engineer and worked as a driller for Humble Oil and Refining Co. in Corsicana, Texas. He was a member of the sales and refinery staffs of Imperial Oil, Ltd. in Canada before joining Ethyl.

He was a track star at Princeton University, where he graduated in 1923. During his athletic career, he won the intercollegiate and national championship in the 220-yard low hurdles in 1922 and set the all-time Princeton record for this event in 1923. He represented the U. S. in the 1924 Olympics in Paris.

Tin Plate Supply to Improve

NPN News Bureau

WASHINGTON — Some easing of tin plate restrictions may be possible later in summer, it was indicated unofficially here following a meeting of industry representatives with CPA.

Industry spokesman said that industry can attain nearly normal production of 900,000 tons beginning in third quarter, after which it might be possible to reconsider present orders which channel 85% of tin plate into food containers and other essential products. Further meeting is scheduled for Aug. 15 at which time the tin plate situation will again be reviewed, with view to easing present limitations.

Krug Holds High Hopes For Petroleum Council

NPN News Bureau

WASHINGTON — Interior Secretary Krug believes new National Petroleum Council will be a success if wartime relationship between PAW and oil industry is carried over to peacetime.

"I thought we had a very good meeting," he said in answer to question at his press conference last week on results of initial NPC conference here (see NPN June 26, p. 4). NPC members gave him "firm assurance of support," he stated.

Asked whether he favored opening doors of future NPC meetings to reporters and industry observers, Mr. Krug said question has "not been finally determined." However, he compared an open-door meeting to Madison Square Garden gathering. Last week's meeting was executive session.

On question of scope of NPC, Mr. Krug declared council should be great help to government in helping settle number of problems, including determination of total oil reserves. For instance, he said, one large producer believes reserves are "inexhaustible" while others in industry take opposite view.

Asked to comment on statement by Sen. Moore (R., Okla.) that formation of NPC was attempt to usurp Congressional control over policy, Mr. Krug said he believed he could convince Moore that NPC is entirely legal and that its function will be to implement present government activities in relation to oil matters.

Jobber Associations Welcome API Move to Expand Board

NPN News Bureau

CLEVELAND — Decision of API board of directors to enlarge its membership by taking in three heads of state jobber associations and the president of National Council of Independent Petroleum Assns. (See NPN June 26, p. 7) brought expressions of approval from independent jobber association officials.

Hugh L. Thatcher, president of National Council of Independent Petroleum Assns., said the action was "very pleasing", a move in the right direction toward giving independents proper representation in API. Date of a meeting planned for appointment of heads of three state associations to the API board has not yet been announced.

Officials of state oil jobber associations in the Midwest cheered the decision as a move in the right direction. O. J. Shaw and Robert Rogers, presidents of Nebraska Petroleum Marketers and Independent Petroleum Assn., applauded the decision. They agreed with API President Boyd that it should go a long way toward cancelling the charge that API is a major company organization, and will more closely unify the industry. (See other story on p. 20)

At API board meeting in Dallas, R. T. Haslam (left), vice president Standard Oil Co. (New Jersey), chats with Robert E. Wilson (right), chairman of board Indiana Standard

W. T. Holliday (right), president Standard of Ohio, listens to a story by C. L. Henderson (center), Vickers Petroleum Co. Charles Roeser of Roeser and Pendleton, Inc., Fort Worth, is at left

API Board Extends 'Grass Roots' Program to Production Division

By Brown Booth
NPN Special Correspondent

DALLAS — Getting on with its "grass roots" program, the directors of the American Petroleum Institute, meeting here, voted to enlarge the number of chapters in the Production Division from 14 to 20. This followed the board's action in enlarging its membership to take in the presidents of 20 trade organizations, with three additional members to come from the state marketing associations (see NPN June 26, p. 7).

The new API chapters will be at New Orleans, Corpus Christi, San Antonio, Midland (Texas), Lake Charles, and Jackson, Miss. The present chapters in the Production Division have 2500 members.

In addition, the directors voted to activate its Rocky Mountain production district, which has been "on paper" for some time but not active because of the scattered production and vast distances. President Boyd said that production has picked up in this region to the extent that it can be made into an active district.

George A. Hill, Jr. (left), Houston Oil Co., and John R. Suman (right), vice president Standard Oil Co. (New Jersey) were caught by camera during informal conversation

Continue Opinion Survey

Results of the public opinion survey made by Princeton University of how the oil industry is faring with the public were not revealed to the press at the meeting. The directors evidenced the importance of the subject, however, by approving continuance of the survey and voting to make it one of the foremost subjects at the national meeting in Chicago Nov. 11-15. One day of the annual meeting will be devoted to this subject, it was announced.

The next directors' meeting will be held in Washington at a date to be named by Mr. Boyd.

Support Agricultural Program

The directors also voted to continue the institute's program designed to link more closely two of the nation's largest industries—petroleum and agriculture. Its main objectives are:

Expanded research into products that combine those of the farm and the oil field, and new uses for them;

Study of insecticides, fungicides, weed destroyers, fruit ripeners, liquid fertilizers, and similar petroleum products;

Furtherance of soil conservation and fertilizer-maintenance programs;

Study of insecticides, fungicides, farm mechanization.

Mr. Boyd said the API expects its committee on agriculture to work closely with government and farm organizations.

"The rapid growth of mechanization has made agriculture an important customer of the petroleum industry," he said. "It is, therefore, only natural for us to help that customer remain prosperous and to assist him in efficient operation."

"Farmers now use more than three and a half million gallons of petroleum products annually, and the total is expected to increase. On its part, the petroleum industry uses directly more than 40 million pounds of farm products."

The API president said there are approximately 2,200,000 farm tractors in use in the nation now, with an expected increase of 200,000 machines annually. The use of petroleum products in flame weeding, cotton picking, tobacco curing, hay drying, wood preserving, and spraying also is increasing, and farm roads continue to absorb steadily mounting quantities of asphalt.

API Arranges Program

NPN News Bureau

NEW YORK — The program was completed last week for the API Division of Marketing meeting on July 10 at Brown Palace Hotel, Denver, which many independents regard as the first test of the institute's "grass roots" plan adopted at the recent API Board of Directors meeting at Dallas.

Speakers at the 2 p. m. session of the Denver meeting will be:

Robert Gray, *Fueloil and Oil Heat*—"Oil Heat."

Howard Page, Standard Oil Co. of New Jersey — "World-Wide Supply and Demand Through 1950."

Wallace Hughes, Hearst Publications—"Features the Consumer Expects from His Service Station."

In the morning the following will report at a business session: Program Committee, B. L. Majewski, Deep Rock Oil Corp.; Lubrication Committee, L. C. Welch, Standard of Indiana; Special Studies Committee, W. L. Faust, Socony-Vacuum Oil Co

Oil Companies in Antitrust Suit Act Patriotically And Courageously in Turning Down 'Consent' Decree

IF AMERICAN big business, such as the oil industry, is honest and lawful in its acts, it should not permit itself to be coerced into accepting "consent" decrees, no matter how seemingly innocuous they may appear to be, just to avoid the great cost in time and money of defending against false government accusations.

If American big business, such as the oil industry, is conducting itself lawfully it has a direct and solemn obligation, not alone to itself, its officers, employes and stockholders, but to all American citizens to stand up and fight phoney suits and indictments brought by government.

If American big business, which has the great financial resources and the highly skilled lawyers, does not thus take up the battle on behalf of the long established and hard-fought-for freedoms of this country, then bureaucratic government that is steadily reaching for totalitarian control over this country, will find itself largely unopposed because the average citizen, Wallace's "the common man", has not the money, the time nor the lawyers to be constantly on the alert against every intimidating act of bureaucracy.

So the 22 major oil companies and their 344 alleged subsidiaries who were all thrown together in a "blanket" antitrust suit Sept. 30, 1940, have done a highly patriotic and courageous thing in standing on their assertions of their innocence and refusing to accept "consent" decrees. This decision was announced the other week by Robert H. Colley, president of the Atlantic Refining Co., who acted as chairman of a temporary defense committee whose lawyers considered the proposals of the Department of Justice for ending the big suit without trial.

The companies insist upon their day in court and that the Department bring out all of its alleged evidence that court and industry and public may see what, the oil companies insist, is a trumped up case for which there is no evidence. Each of the 366 defendants will demand all the rights of a defendant for a fair trial, that each is to be represented by its own counsel and that each counsel exercises all his rights to cross examine witnesses and make all necessary arguments. Even if the trial runs for several years, these oil companies say they are entitled to whatever time is necessary for an honest and legitimate hearing of the accusations of the Department of Justice and of the oil companies' defense.

This is a courageous decision by these oil companies because there are many hazards for them no matter how 100% innocent they may be. These hazards briefly are,—

1—The particular judge or judges before whom the case might be tried might easily be highly biased against the free enterprise system as Roosevelt frankly said at the time of his unAmerican raid on the federal judiciary that he was interested solely in naming men who would decide cases in conformance with his pet political ideas.

2—The case undoubtedly will go to the U. S. Supreme Court where Roosevelt appointees are in the great majority and where they have been most diligent in carrying out his totalitarian and socialistic ideas. This is substantially the same court that found it necessary to change the interpretations of its predecessors in order to hold even the lone 5 defendants left out of 58 in the infamous Madison oil antitrust case of 8 years ago. The Supreme court made this change in order to save some of the case for the government after a particularly capable Circuit Court of Appeals had held against the New Deal.

3—If the Department of Justice conducts itself in this case as it did in the Madison case, these major oil companies will again be subjected to false statements, to faked evidence and to gross misconduct by the Department's own attorneys. Their misconduct in the courtroom in the Madison case was severely condemned by a Circuit Court as being unduly prejudicial to the defendant. It was misconduct so flagrant that even the already biased Supreme Court gave serious and condemnatory consideration to it in its opinion. In fact for all they know these oil companies may again be the victims of what another federal court described as a fraudulent jury, in the Madison case that being the first grand jury that passed on the Department's alleged evidence.

4—There are many other ways in which a vindictive administration can make trouble for big industrial companies; by false tax investigations and suits; by actions of its various law enforcing authorities under all the many new laws on hours, wages and other regulations of the war; by again siding with the labor unions and supporting their highly inflationary demands and by further suits and indictments by this same Department of Justice. All this is not fancy. In fact it was promised by Roosevelt in his campaign for re-election the first time, that he would be "the master", and that election was promptly followed by continual attacks on big industry including the Madison oil case.

5—If the government undertakes to put in "testimony" on all its charges in this present blanket case the trial is quite likely to run for a long time, easily longer than the four months of the Madison case. Such a long trial will cost a great deal of money to say nothing of many months of time of industry officials and employes. The Madison case has been estimated to have cost the oil companies involved more than $6,000,000 though no official figure has ever been issued. The present case should be several times that.

Finally all these hazards, it is conceivable, might result in a decision for the government no matter how innocent the companies may be. The political pressure from the administration for favorable decisions undoubtedly would be tremendous, unless this administration changes its spots quickly. Then there is always the chance that the present Supreme Court might again change the law regarding antitrust violations, just as it did in the Madison case, which is like shifting the goal posts after the player starts to run with the ball.

A full trial of this case is highly desirable to all concerned,

READERS' comments and opinions will be much appreciated by Warren C. Platt, NPN's Editor and Publisher, Penton Building, Cleveland 13, Ohio.

as well as to the country, in order to bring out clearly for the citizens to see to what extent the administration is undertaking to settle economic and political problems through courts of its own appointment. To carry out this policy of having "judges" make the law instead of Congress, the New Deal instituted an era of "administrative law" whereby appointees of various government agencies set up their own rules of conduct and their own "judges" and prosecutors to try the alleged infringers of those rules. In short the administration has tried to write its own answers to all problems without asking advice of Congress or the people or even of semi-judicial agencies established by Congress.

Some of the questions involved in this blanket oil case, one might think, belong to some already established bodies while the seemingly main question of "bigness" and possible divorcement as a "cure", belongs still to Congress.

The problem of pipeline operation and reasonableness of rates and shipping conditions was assigned by Congress 40 years ago to the Interstate Commerce Commission. The only case that any protesting oil men ever brought before the Commission after its authority was upheld by the U. S. Supreme Court was decided substantially in their favor and no one has made further complaint to the ICC. The pipelines have been operating under that ICC decision ever since. In this blanket suit the government would seemingly take the matter away from the Commission and without consulting it.

There also are questions raised in this case regarding the fairness and legality of owner and lessor control of filling stations which they have built and equipped, their exercising control over the sale of products therein, and the national advertising of petroleum products. These matters heretofore have been considered in the realm of "unfair competition" and subject to the Federal Trade Commission. Some of these questions, if recollection is correct, have been informally rejected by the Commission as not being violations of law. Oil men and other industries may believe that these questions should be first reviewed by the Commission or by Congress before being "settled" by a court that may know little or nothing about business operations.

Then there is the main question in this as in many other similar cases recently, of when does "bigness" become monopolistic in violation of the present law? Here the point may fairly be raised is this a matter of law for an ordinary judge to decide or is it a basic question of American economic policy for Congress to write the limitations, if any?

Along with this "bigness" is the "remedy" and here the present Attorney General has some ideas. He gave them to the Senate and House Small Business Committees recently. In his opinion he would have the courts, acting under the antitrust laws, determine when and how "big business" should be and then subject the defending big companies to "divestiture", "divorcement" or "dissolution." Presumably he would apply some of these "remedies" in this blanket oil case as per the "wisdom" of the presiding judge.

But are these questions that can best be decided by a single judge or group of them?

That the old Standard Oil Trust was "dissolved" back in 1912 does not necessarily mean that each department of a company if separately owned and operated would give the public the best service and product at lowest cost in the long run? In fact, while that dissolution case broke up the old Standard largely into its operating departments, each such former department, with two exceptions, have since accumulated supplementing departments so that each is now a completely integrated oil unit. The two exceptions tried to stay single and died.

The country may well pause and consider whether it is in its best interest for economic and political questions of this importance be decided by a single judge on "facts" and theories presented by a group of lawyers belonging to an administration that has long been notorious for more and more government control of all business, or would the country's best interests be better served by Congress making the final decisions?

The oil industry has long indulged in many and heated discussions of these questions. If the government's facts and argument are brought out at a full and thorough trial in this oil "Mother Hubbard" suit the industry will at least have that information to add to its discussion regardless of whether the court's decision is fair or not. At all events such a disclosure of facts it may well be argued, would be of greater benefit to the industry and the country in the long run, than to have an entirely uninformative "consent" decree that undoubtedly would have some effect on these questions but it would only be an effect molded by the political interests of the Department of Justice and the administration weighed against the amount of time and money the defendants could save by avoiding trial, and all colored by the horse trading ability of the two sides. That is hardly the way basic industrial and economic questions should be decided.

So the major oil companies, in deciding to stand pat and fight what they describe as false accusations, are not only making it possible for the oil industry and the public to get a thorough presentation of the facts and theories of these practices that have long been under discussion, but these major oil companies are also saying to the Department of Injustice and the reforming and totalitarian administration which it represents, to get down to facts, all the facts, and sound law, and quit the bullying and false accusations and unfair propaganda by which the New Dealers have been trying to obtain more and more control over all business for the bureaucracies at Washington.

Petroleum Council Members Should Recall New Deal's Past Double-Crossing of Oil

THE foregoing editorial on the conduct and policies toward big business of the New Deal and its Department of Injustice, reviews at least some of the reasons why the oil men selected for membership on the new National Petroleum Council should make sure that there will be no double-crossing in return for their service to the government.

One does not appear to be very much justified in putting any particular faith in the fair conduct of the New Dealers. Following the oil industry's co-operation with the New Deal in the NRA code days, the New Deal instituted the Madison case even though the oil industry did only what it had been authorized to do under its code and under the direction of the New Deal and under the personal management and approval of "Honest" Harold Ickes then administrator for the code.

To make this double cross by the Roosevelt administration still worse, Ickes cowered in his office at Washington and refused to take the witness stand during the Madison trial and testify to what he had authorized the oil defendants to do. Ickes told the oil men who appealed to him to come out from hiding, that if he was a witness for them such an act by him would "blow up the cabinet."

There should be little question but if Ickes had vigorously stood up for the oil men, hammered on the presidential desk if necessary, when he first heard of the Roosevelt-Cummings attack, he would have won that fight. But if he had had to

NOW...WE KEEP THEIR NOSES OUT of our business

THE porpoise—or as some know it, the bottle-nosed dolphin—carries in its head a blubber, from which, after four years of processing by a secret method, was refined the world's finest and most expensive oil. However, according to government sources, the quality of this oil declined with the death of its inventor.

Requested by the Navy to find a substitute, Cities Service Research, after a year of laboratory work and nine months of proving by the Bureau of Standards, developed a successful substitute out of petroleum.

Used in chronometers, electric meters, observatory instruments and other precision equipment, this oil *stays put* on the finest bearings. *It does not* spread like ordinary oil...nor is it likely to oxidize, or become gummy. And it will lubricate at temperatures way below zero. All this means that tremendously costly instruments—frequently upon which many lives may rely—now may last longer and perform *dependably*.

The oil costs—take a deep breath—$1,100 a gallon! It is sold in little bottles 5cc in size, and is applied with a fine wire which has been dipped in the oil and then drawn across the tiny bearing and its pivot, to leave just a trace.

Considering that ⅓ of a drop is required for the bearings of a 21-jewel watch, the 61,400 drops in a gallon would lubricate 3,868,200 bearings for less than a third of a cent each... and provide every one with the finest protection known to science.

Out of just such research and mature experience, Cities Service is in a better position than ever to help industry to improve its efficiency of production and quality of output. *Cities Service Oil Co., Sixty Wall Tower, New York 5, N. Y. In the South, Arkansas Fuel Oil Co.*

CITIES SERVICE OILS

service is our middle name

leave the cabinet it certainly would have been under far better circumstances than when he finally was practically tossed out by Truman for carrying a personal feud to the White House.

There are some new faces in high places in Washington but the old policies and ideologies still seem to rule, so oil men should continue to guard as best they can against further double crossing by this administration.

Union Mob Violence Can Be Halted With Laws Already on the Statute Books

MOB rule has long been the mainstay of union organizing and maintenance methods. And cowardly acquiescence in such violations of law has, unfortunately for the American public, been too long the outstanding attribute of a large number of our public officials and judges, including those in the cabinet and the White House at Washington.

Around Joliet, Ill., just as around Detroit, unions are using the threat of mob violence and the arbitrary and unlawful exercise of their monopolistic powers, to force operators of small bulk plants and particularly service stations, to "kick in" to the union's treasury under the guise of "taking out a membership" or the stations are not allowed to operate. Such is nothing but extortion, the same kind of extortion for which Congress passed a law against Musicians' Union Petrillo, and the same kind of extortion and intimidation that Congress sought to prevent teamsters unions especially from inflicting on the lawful users of our highways.

However such extortion by threat of mob violence received the approval, in effect, of President Truman when he vetoed a recent bill to deprive unions of this mob violence privilege.

It also is against mob violence in direct violation of law that the Pure Oil Co. obtained an injunction at Toledo the other week. Here strikers were blocking the entrance of supervisory employes who would have stood guard within the plant against fire, electrical storms and other hazards of a shut down refinery. The company finally had to get an injunction prohibiting interference by force—mob violence—with the entrance of these employes. Fortunately for law and order, the company found a judge and a sheriff brave enough and honest enough to enforce this fundamental of all law.

President Truman scolded Congress when he sent his veto message against a bill that would have restated the law against mob rule. He said this should be given serious study, that such had not been done. Evidently Truman never read or heard of this basic law against mob rule, or else, as his actions more and more indicate, he is president of the U. S. FOR the CIO and not for the people.

There used to be a time, before Roosevelt sold the country out to the unions, when courts could be found that would order mobs to stop and when mayors would request governors to call out the national guard or, even, on occasion, the regular army. But the unioneers have so cried this ancient practice down that a large number of public officials today act as if the law specifically authorized unions to take physical possession of any property it desired in the name of "picketing" and to interfere with the peaceful coming and going of citizens.

If hesitant Harry would sound a call to all officials in this country to enforce strictly all laws against mob violence, extortion, hi-jacking and interference with the lawful rights of all citizens, and then tell the unioneers that, if necessary, he would call out the army to enforce order against the perpetrators of these crimes, there is little additional law that he would find we would need to adorn our statute books, to cut these union racketeers and cowardly officeholders down to size.

Pew Answers Charges Made by CIO Speaker

PHILADELPHIA—J. Howard Pew, president, Sun Oil Co., speaking over an American Broadcasting Co. network June 22, replied to attacks levelled at the Pew family by Walter Vaughn during a CIO-sponsored program over the same network a few weeks previously.

Characterizing Mr. Vaughn's charges as false, Mr. Pew quoted from records to point up the ambiguity and fallacy of various statements made by the CIO speaker. Mr. Pew said, in part:

"Now as to the charge that I desire to 'exploit labor' and destroy competition by monopolistic means, my actions speak louder than any words of mine could.

"The American petroleum industry, according to the Bureau of Labor Statistics, is and always has been one of the highest wage industries in the country. Today it tops the list. Sun Oil Co. always has paid and provided employe benefits as high or higher than oil companies with which we compete . . . .

"It always has been our belief and practice that no business is truly successful unless its success mean something substantial for its workers . . . . Our philosophy always has been that business and industry render their greatest service to the nation when they constantly produce better commodities and services at lower prices through an efficiency that reconciles a low cost policy with the payment of high wages."

Citing Mr. Vaughn's charge that Mr. Pew opposed continuation of OPA, the Sun president said:

"I deny . . . . that continuation of OPA is in the interest of higher living standards for labor, farmers or the country as a whole. On the contrary, the record before Congress is clear that OPA has impeded industrial production and has been a wall between 100,000,000 consumers and the goods they want and need.

"What is more, if OPA continues unchanged for another year it will perpetuate scarcities and shortages of needed goods, thus encouraging inflation and further reducing the purchasing power of the consumer's dollar.

". . . . . Throughout all history price control schemes . . . . have brought disaster in their wake. Price controls in peacetime cannot be made to work without increasingly severe, additional restrictions, thus eventually destroying competitive enterprise and individual freedom. When that happens labor will be the first to suffer.

". . . . All this is still the old NRA fight that aroused our opposition 13 years ago and will keep us protesting until these hypocritical fallacies are ended for good, until the discredited Blue Eagle . . . . is buried too deep for another resurrection and until freedom, under God, is restored to the American people."

Cut in Funds for OGD Snags Organization

NPN News Bureau

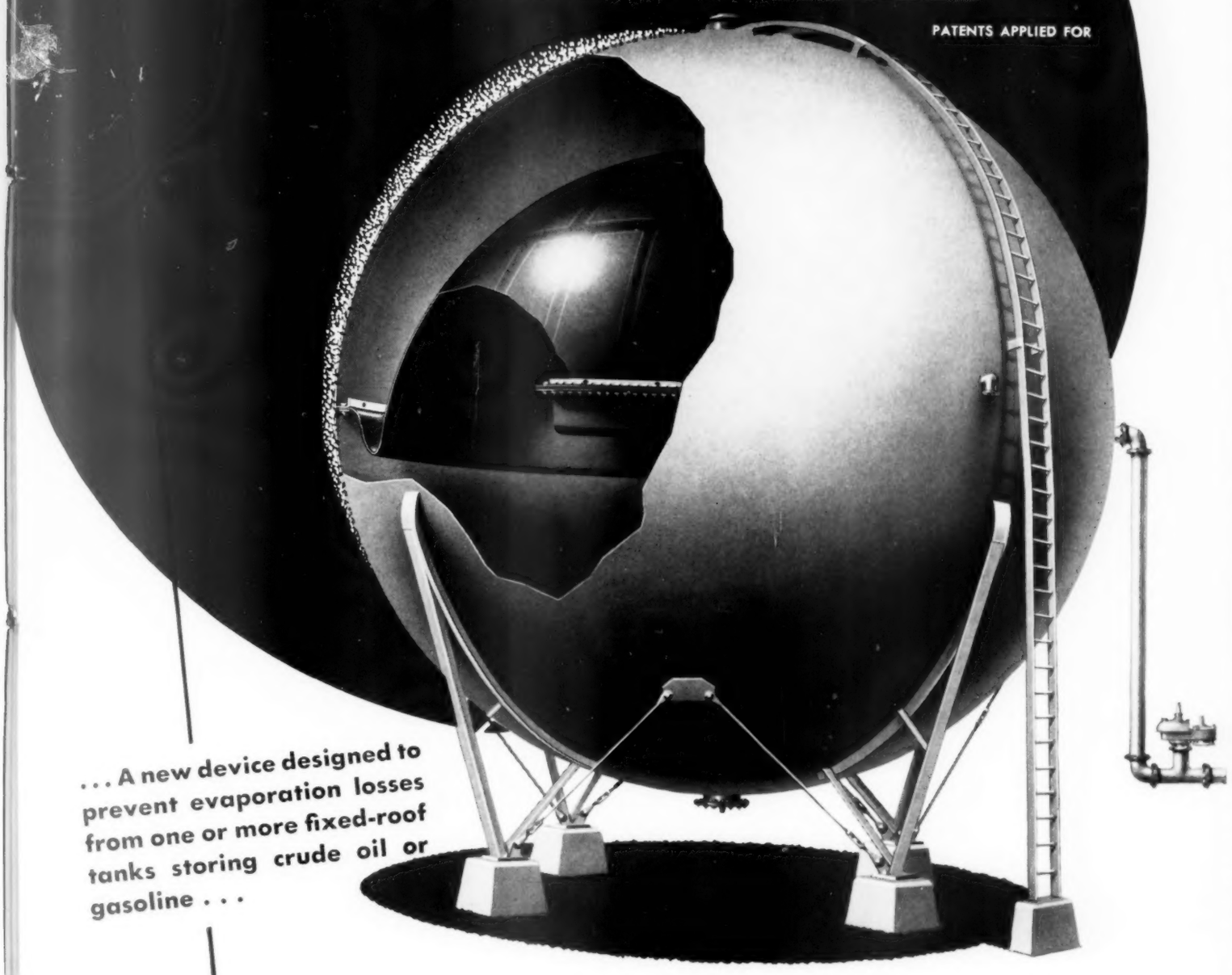
WASHINGTON—Plans for organizing Interior Department's Oil and Gas Division have been complicated by fact that Congress voted but $400,000 for agency, of which only between $160,000 and $180,000 will be available for hiring of personnel to carry on functions other than those related to Connally Hot Oil Act.

Acting OGD Davies had figured $300,000 as absolute minimum needed to finance new activities. This would have enabled hiring of 60 employes. However, Budget Bureau cut total to $225,000, allowing for staff of 47, and Congress further reduced sum by slashing total proposed OGD appropriation $49,516, practically all of which must come out of funds tentatively earmarked for new activities.

Agency thus faces task of trying to organize with an appropriation that is only 55 to 60% of what it believed minimum necessary and as matters now stand probably will have to limit itself initially to staff of 37 or fewer employes. Unless idle funds can be obtained from other Interior Department bureaus, only recourse OGD would have would be to seek deficiency appropriation from new Congress in January.

the VAPORSPHERE

PATENTS APPLIED FOR



. . . A new device designed to prevent evaporation losses from one or more fixed-roof tanks storing crude oil or gasoline . . .

The Vaporsphere is the petroleum industry's newest evaporation-saving device. It is particularly suited for use in vapor-saving systems at tank farms, pipe line terminals, refineries, bulk stations and marine terminals where crude oil or gasoline are stored in fixed-roof tanks. One of the most attractive characteristics of the Vaporsphere is the extreme simplicity of its operating principle. It normally operates at a pressure of from ⅛ in. to ¼ in. of water and reduces evaporation loss by preventing the escape of vapor.

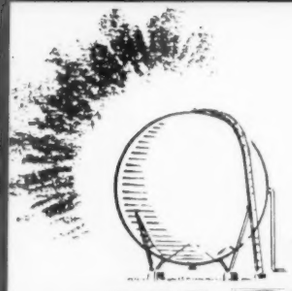
The vapor line from the storage tanks is connected to the shell just below the equator. As the vapor enters the Vaporsphere (between the lower half of the shell and the membrane) the membrane billows upward to make room for the incoming vapor. At the same time, an equal volume of air above the membrane is displaced through a vent at the top of the shell. When the conditions which caused the vapor to enter the Vaporsphere are reversed, the vapor returns to the storage tanks, the membrane descends and air enters the space above it through the top vent.

The membrane is backed up by the top half of the shell when the Vaporsphere is full of vapor and by the bottom half of the shell when the Vaporsphere is empty. A pressure and vacuum relief vent in the inlet line safeguards the Vaporsphere and the storage tanks from a pressure or partial vacuum in excess of the safe working range of the system. In addition, each tank is equipped with pressure and vacuum vents.

The Vaporsphere is a Horton product built by the Chicago Bridge & Iron Company, designers and fabricators of the IMPROVED *Horton Floating Roof and other evaporation-saving products for the petroleum industry.*

CHICAGO BRIDGE & IRON COMPANY

SEE OTHER



THE NEW HORTON

VAPORSPHERE

Advantages of the VAPORSPHERE

- **Easily Installed**—A Vaporsphere can be erected and connected to a group of storage tanks without taking them out of service.
- **Dependable Operation**—Vapor lines of relatively large diameter are used to connect the Vaporsphere to the tanks. Vapor flows through these lines unobstructed.
- **High Efficiency**—The Vaporsphere normally operates at a pressure of from ⅛ to ¼ in. of water. When the sphere is partially filled, the air space above the membrane serves as an insulating medium.
- **Low Operating Cost**—A vapor-saving system incorporating a Vaporsphere operates automatically, by natural forces. No power is needed and there are no operating costs aside from ordinary maintenance.
- **Fire Safety**—The Vaporsphere and vapor lines are usually filled with an air-vapor mixture above the explosive range, reducing the danger of fire in the system.

WHAT IT IS . . .

The Vaporsphere is a spherical steel shell with a hemispherical membrane made of flexible material on the inside. The edge of this membrane is fastened to the shell at the equator.

WHAT IT DOES . . .

It is designed primarily to serve as the "heart" of a vapor-saving system by providing temporary storage for vapors which are forced out of the storage tanks to which it is connected.

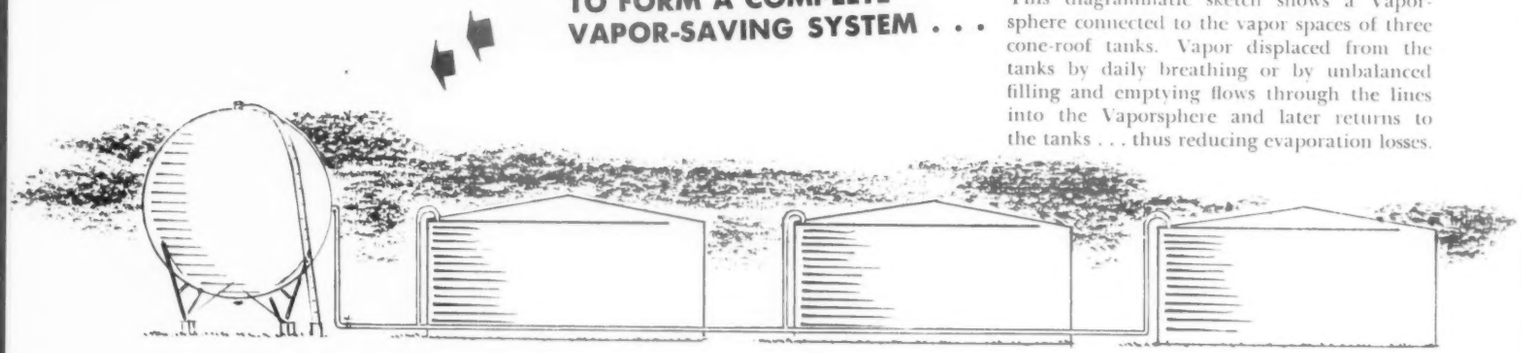
HOW IT WORKS . . .

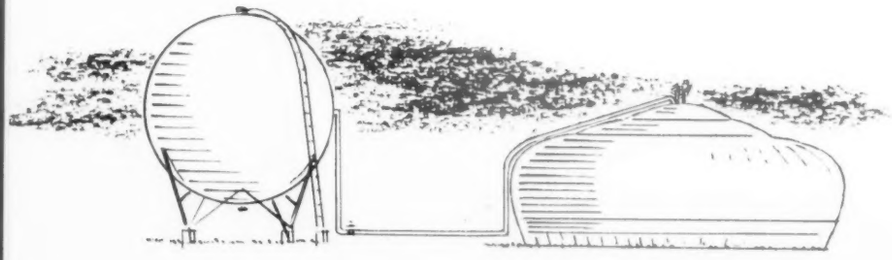
Breathing, caused by daily temperature changes, or unbalanced filling and emptying forces hydrocarbon vapors out of the storage tanks. These vapors flow into the Vaporsphere through large diameter vapor lines. When the conditions which caused the vapors to be displaced are reversed—they return again to the tanks. Thus, by preventing the vapors from leaving the system — *evaporation losses are prevented.*

For more complete details on the Horton Vaporsphere, write our nearest office.

HOW TO USE THE VAPORSPHERE TO FORM A COMPLETE VAPOR-SAVING SYSTEM . . .

This diagrammatic sketch shows a Vaporsphere connected to the vapor spaces of three cone-roof tanks. Vapor displaced from the tanks by daily breathing or by unbalanced filling and emptying flows through the lines into the Vaporsphere and later returns to the tanks . . . thus reducing evaporation losses.





In addition to using the Vaporsphere to prevent evaporation losses from groups of fixed roof storage tanks, this new device may be used to reduce *filling* losses from pressure vessels such as Hortonspheroids or Hemispheroids which operate at pressures of approximately 2½ lbs. per sq. in. by equipping the air vent at the top with a pressure regulator and operating the Vaporsphere at the same pressure as the tanks.

CHICAGO BRIDGE & IRON COMPANY

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Plants in BIRMINGHAM, CHICAGO and GREENVILLE, Pa. • In Canada: HORTON STEEL WORKS, LIMITED, FORT ERIE, ONTARIO

Sales Incentives Plus Efficient Bookkeeping Add Up to More Profits

Successful Oil Jobber Uses 'Open Top' on Sales Commissions; Maintains Control of Inventories And Costs with an Efficient Bookkeeping System

Leroy L. Snyder (second from left), president of Nebraska-Iowa Oil Co., discusses some bookkeeping matters with A. W. Johnson, secretary-treasurer

By EARL LAMM
NPN Staff Writer

An Independent marketer last year sold $902,746 worth of merchandise in the town of Blair, Neb., population 3289, and the surrounding six-county trade area within 25 miles of Omaha. This was double his sales volume before the war.

This marketer is Leroy L. Snyder who is president of the Nebraska-Iowa Oil Co. The company distributes Socony-Vacuum petroleum products. TBA and small automotive parts are obtained from various sources, preferably nationally advertised brands.

In the shaping of his business, Mr. Snyder declared these things important:

1. Hire capable men, then allow them sufficient liberty to fully function.
2. Put all employes possible on an "open top" sales commission with increasing percentages as their volumes go up.
3. Avoid high pressure over-selling.
4. Keep clear and accurate accounting records to eliminate guess work.
5. Keep business on a sound financial basis and carefully build a reputation for responsibility with all sources of products, merchandise and equipment supply, as well as with customers. Deal squarely with them all and with employes.
6. Always speak well of your major oil company supplier and suppliers of merchandise—or switch to other sources.
7. Handle only branded products and merchandise of standard quality and established value.

These are simple ideas, most of which have been heard before, but the manner and force with which they are carried out is what counts. The exact amount of Nebraska-Iowa Oil Co. sales in 1945 was $902,476. The business was done through 14 company owned bulk plants and 37 dealer stations, and with the aid of 16 tank wagons, a wholesale parts department and a parts truck that covered the territory for on-the-spot sales and deliveries to service stations, garages and repair shops. Most of the 37 service stations are company-owned and are subleased to the operators as the company does not engage in direct operations. Two of the bulk plants, located at Colon, Neb., and Dennison, Ia., are new, having been opened since end of the war.

The six counties where Nebraska-Iowa Oil Co. operates are Saunders, Dodge, Washington and Burt in Nebraska, and Harrison and Crawford in Iowa.

Perhaps most significantly indicative of aggressiveness, was the increase of 133% in sales volume during the past five years — a period when everything they needed to sustain business had to be fought for tooth-and-toe nail. It required persistence and patience to maintain anything like an adequate TBA and small parts inventory to step up sales at Nebraska-Iowa Oil Co.

"But I guess I partly succeeded," Mr. Snyder said, "since our sales did increase."

Now that the supply of parts is freeing up, another parts truck is being added for closer, more diligent working of the territory with the aid of new county maps showing the location of farm homes, garages, service stations

and other buildings important to oil and parts marketing.

"We are also buying 10 new light trucks and eight new delivery tanks of 700 to 800 gal. capacity, except one, which will be 1000 gal.," Mr. Snyder said in discussing new equipment. "All of our farm trucks are equipped with power take-off pumps and meters, which speed delivery by 25% and help tank wagon men make more money. We started adding them in 1941 and finished in 1945," he said. "During the last few months we have purchased 14 new Bowser service station pumps, Petinco equipped."

The Petinco system of coin operated attachments for station pumps is used at all dealer stations. Slugs for the coin machines which deliver a predetermined gallonage per slug, are deposited at nearby local banks where each dealer can conveniently buy them. Dealers thus pay for the gasoline as it is sold through the pumps.

Incentive Personnel Plan

A new bonus and seniority payments plan has been worked out and put into effect for the company's 30 employes. There has been no labor difficulty and no union is involved. Nineteen of the 30 employes have been with company two years or longer and are entitled to participate in the new benefits. Eleven of them have been with the company for more than five years; that is, throughout the war period. Expansion of activity during that time required the addition of some new men.

Announcement of the bonus and seniority benefits plan was made at a dinner for employes on the evening of Jan. 24. Bonus payments amounted to 10% of the annual salary last year of participating employes, and were made in preferred stock of the company. All net profits, after setting aside interest on the capital investment, Federal income tax and 10% reserve to surplus, were distributed as a bonus in which Mr. Snyder personally did not participate.

Seniority benefits are $3 for each year of employment for employes who have been with the company from two to five years; $7.50 per year for six to 10 years, and $10 per year for men who have been with the company 11 years or longer. Thus, men on the payroll for 10 years draw $75 a year extra for their seniority, and the one man who served for 19 years got $190. These seniority benefits were added to the 10% bonus on annual salaries.

"I guess I've been lucky," Mr. Snyder explained in commenting upon his success, "but I have always wanted to hire married men with kids. They are more home-loving and most likely to be steady and responsible. I think as much or more of my employes than I do of my business. Most of them have been with me for a long time—one for 19 years. That's why I lost few employes during the war and is also why I decided last year to let them participate in the profits of the business. I finally worked out the bonus arrangement, which I have dreamed about for a long time. In addition to helping them, I want to

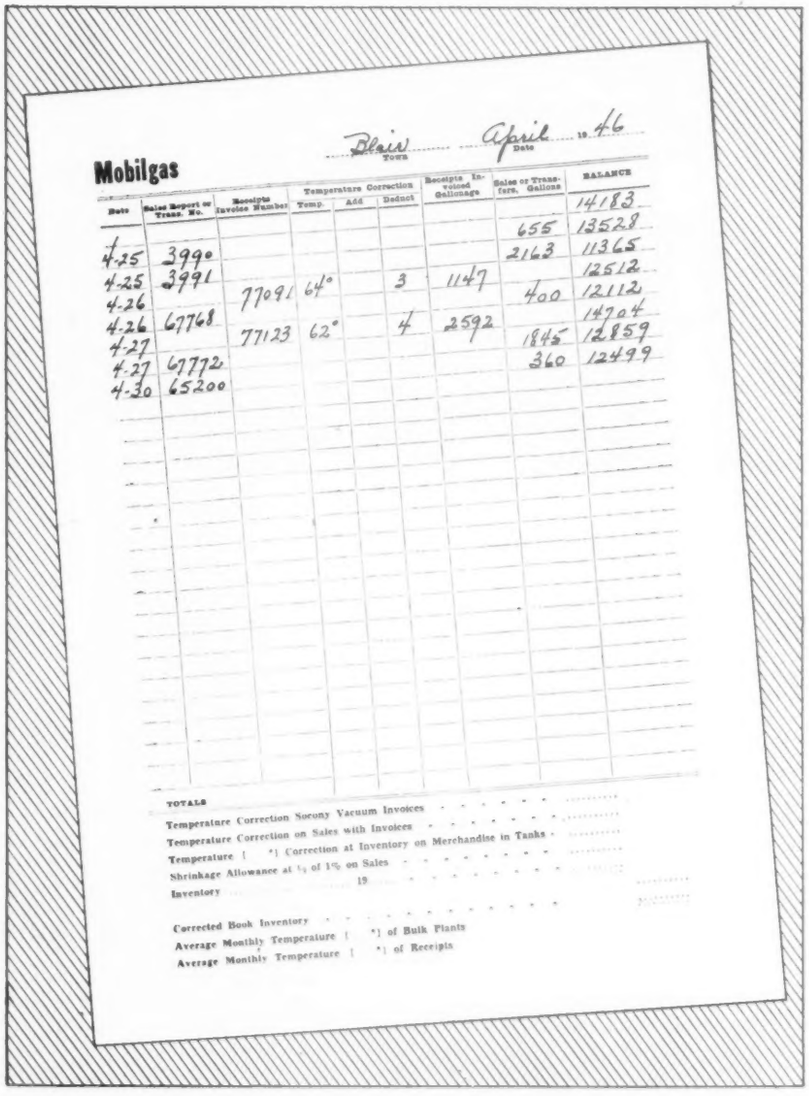
'Open Top' Incentive Plan

Here's an example of how the incentive "open top" sales commission plan works in building sales volume:

One tank wagon salesman started to work with Nebraska-Iowa Oil Co. in 1940. His net over-all earnings on basis of volume sales were:

1940	$1,816.15
1941	2,154.68
1942	2,706.94
1943	3,475.31
1944	3,969.72
1945	4,679.35

All salesmen are not that effective, but earn according to their abilities. Another man earned $1,241.53 in 1937, his first year, but drew $3,843.47 during 1945, which was a 200% increase. Low man on the sales force more than doubled his income in nine years.



Mobilgas

Blair (Town) April (Date) 19 46

Date	Sales Report or Trans. No.	Receipts Invoice Number	Temperature Correction Temp.	Add	Deduct	Receipts Invoiced Gallonage	Sales or Transfers, Gallons	BALANCE
								14183
4-25	3990						655	13528
4-25	3991						2163	11365
4-26		77091	64°		3	1147		12512
4-26	67768						400	12112
4-27		77123	62°		4	2592		14704
4-27	67772						1845	12859
4-30	65200						360	12499

TOTALS

Temperature Correction Socony Vacuum Invoices .....

Temperature Correction on Sales with Invoices .....

Temperature [*] Correction at Inventory on Merchandise in Tanks .....

Shrinkage Allowance at ½ of 1% on Sales .....

Inventory ..... 19 .....

Corrected Book Inventory .....

Average Monthly Temperature [*] of Bulk Plants

Average Monthly Temperature [*] of Receipts

Refinery temperature corrections are a headache to jobbers who sell on a straight gallonage or shell capacity basis. This card record is kept for each separate product at each bulk plant. It shows receipts in gallons, amount delivered to tank wagons for sale or transfer elsewhere. Temperature corrections and shrinkage are figured near bottom of page. They show actual losses or gains—not guesses. Gives double-check on receipts and sales ledger

Nebraska-Iowa Oil Co. rents stations on an "open top" basis similar to its jobber salesmen's commissions

give them every incentive to get business. That helps me," he said.

He regards good bookkeeping and alert, contented and capable employes the most solid foundation upon which any business can be built. He put them foremost on the list of requirements for success of ownership and management.

Two employes in private conversation on separate occasions several days apart, expressed to this writer, their loyalty and appreciation of their boss.

"I would do anything he asked," said one, "for I know he would not ask anything either unreasonable or dishonest. He is fair—and that bonus!"

"Working like I do on an 'open top' commission," said the other, "I pay no attention to hours. I never did believe in watching the clock, and the added incentive of increased commission percentage as my sales go up, keeps me digging. My wife never knows when to expect me home for dinner, but I don't get in the doghouse often because she knows I'm scratching for that extra percent."

The "open top" commission, or sales incentive, is a reversal of standard business methods, which put salesmen on a flat commission or cut back the commission percentage as volume goes up to keep the salesmen from making too much money.

"It is recognized," Mr. Snyder said, "that every salesman and every business has a more or less fixed overhead, and after that is earned each month, the percentage of profit on volume goes up."

Mr. Snyder divides that added profit with his salesmen by increasing their sales commission as their volume climbs. Since he puts no limit on their sales volume nor on the amount of money they can earn, he calls it "open top" commission. All of the 30 employes of the company work on that basis, except strictly office help—and they would be on it too if a way could be found in which to do it. However, by continued employment, all have the opportunity of participating in the annual bonus and seniority benefits.

As the company does not engage in direct retail operations, rental of owned or controlled service stations leased or subleased to operators is on a similar "open top" basis. Rental charges are drastically reduced as gallonage sales go up, which enables the dealer to earn more net profit. Here is how it works:

"Take a station with three stalls—a wash rack, grease rack and repair stall," Mr. Snyder said. "The dealer pays us a flat rental of $15 a month for each stall, or a total of $45, which helps takes care of the overhead. The 'open top' comes in on gasoline sales by reduction of rental charges from 1c gal. to ¼c gal." Here is the schedule:

1c gal. rental on the first 5,500 gal. of gasoline sold each month. ¾c gal. rental on the next 2,500 gal. of gasoline sold each month. ½c gal. rental on the next 2,000 gal. of gasoline sold each month. ¼c gal. rental on the next 1,000 gal. of gasoline sold each month.

Thus, a dealer with a three work room station, who sells 8,000 gal. of gasoline a month, pays $118.75 total monthly rental; but if he sold 11,000 gal.—an additional 3,000 gal.—he pays only $12.50 more rental. The jobber's profit comes from the added sale of gasoline, not from station rental. The station is regarded merely as an outlet location for products. Same thing applies to the 3-stall service shops where lubes, greases and automotive parts and accessories—supplied by Nebraska-Iowa Oil Co.—are retailed.

Comparison of Sales 1945 over 1944

Sold at	Gasoline, burning oil, tractor fuel gals.	Increase over 1944 %
Service Stations	1,965,653	25
Other than service stations	2,746,134	26
Total	4,711,787	26

Sold at	Oil and greases gals.	Increase over 1944 %
Service stations	42,245	42
Other than service stations	49,457	29.8
Total	91,702	35.5

NOTE: Lube oil and grease sales for 1945 were 2.4% of total gasoline, burning oil and tractor fuel sales. Goal for 1946 is 3%.

Jobber Must Meet High Standards

"It has been my observation," he continued, "that companies—oil companies and TBA and parts manufacturers—having the highest advertised brands are the easiest people to do business with if you check up to their standard of operations. They do not want fly-by-night dealers and distributors. All any big company wants is honest, fair representation of their products. Because of their excellence and the advertising, they have ready customer acceptance. Half of the sales resistance is broken down by brand names, which means more profit for me, since sales expense is reduced.

"Too much emphasis," he declared, "cannot be put upon the choice of products and merchandise handled, for that

SILOO FUEL OIL TANK SOLVENT FOR MAXIMUM BURNER EFFICIENCY

SILOO FUEL OIL TANK SOLVENT is the positive, safe method of cleaning fuel oil storage tanks and equipment. This easy-to-use liquid disperses water due to condensation—clears clogged pipe lines, oil filters, strainers and burners. Just pour it into the tank. By using **SILOO,** free flow of oil for improved combustion and heater operation is assured.

SILOO FUEL OIL TANK SOLVENT is absolutely harmless to fuel and equipment. It is non-inflammable, non-explosive, non-toxic, non-corrosive—always safe to store and use. Ideal for space heaters, oil stoves, kerosene lamps, Diesel engines, etc.

SILOO FUEL OIL TANK SOLVENT is nationally advertised and boasts a large, eager market. Distributors and jobbers—take advantage of this widely accepted product—write for details today!

SOLVENTS FOR ALL TYPES OF PETROLEUM RESIDUES

Petroleum Solvents CORPORATION

(Tank Solvents Division)

General Offices: 331 Madison Avenue, New York 17, N. Y.
Plant and Laboratories: Port Reading, New Jersey
Petroleum Solvents Corp. of Canada, Ltd.
Dominion Square Bldg., Montreal

choice works two ways—on the customer and on the salesman. If capable men are hired in the first place and given an income equal to that paid by competition, the men need little training. Chances are they are already familiar with the choice merchandise and can honestly recommend it. We get full sales co-operation from our suppliers, but never allow our sales department to overload or force merchandise upon inexperienced buyers. Give the customer benefit of the doubt—that still works. High pressure selling—we never do it. We have no funny wrinkles for getting business."

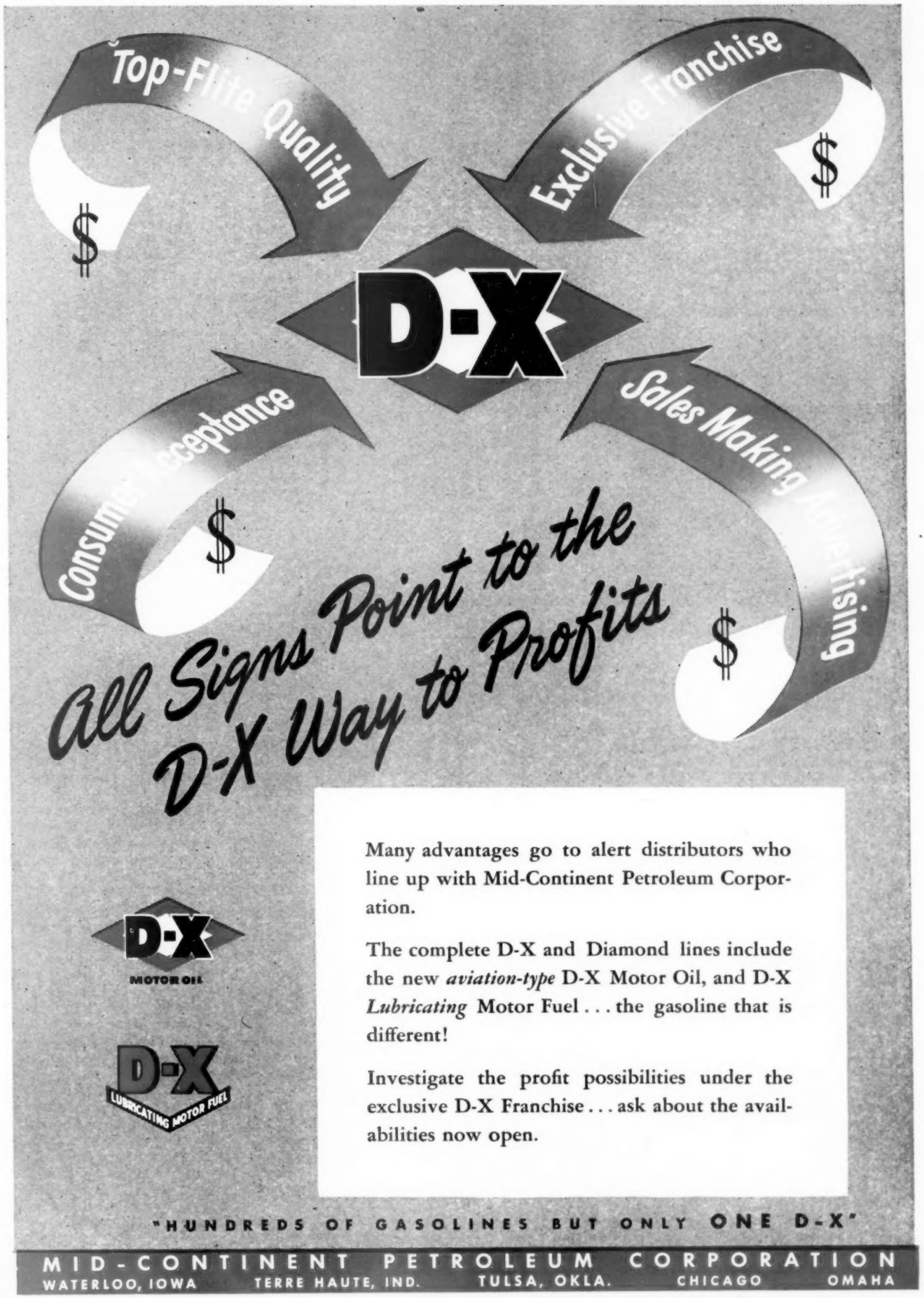
When endorsing brands, Mr. Snyder made it clear that he recognized that there are two types of marketer. "One —the branded product, which waters the battery, the radiator, inflates the tires, washes the windshield, brushes out the front compartment, and performs any other little service that the customer might want."

The other is the track-side operator, or price marketer. No effort is made to compete with him on his price basis. "I don't think the two could ever be brought together and combined into one type of marketer," Mr. Snyder said, "but I feel there is room for both in our economic setup.

"As for assisting our sales force," he continued, "of course we do that, but our tank wagon men and others are never given a fixed route and told to go down this or that road calling on a pre-determined list of customers and passing up the others. Whenever we assign a man a territory," he said, "we sit down and go over it with him, telling him what he will find there and how we think it ought to be handled. Then we turn him loose to work it as he sees fit. If he is as capable as we thought he was when we hired him, he'll get the business. As time passes, we counsel with him on his problems and answer his questions. All our cards are played face up with both salesmen and customers. We encourage our men and dealers to sell our complete line of products and sundries, and not stick to a few items that happen to sell easily at the moment.

"The more our salesmen and dealers earn," Mr. Snyder said, "the better we like it. We want them to pay a big income tax. While we avoid high-pressure selling, we urge them to keep asking people who are not customers to buy. To build confidence, we show them we have good products and service and are honest. I suppose you'd call most of our sales contacts just visits with people. It puts them at their ease by showing them we are human. Their guard comes down, and they can make clear, satisfactory buying decisions that stick. They don't feel cheated at being oversold afterwards."

Advertising Stimulus — In advertising


Top-Flite Quality
Exclusive Franchise
D-X
Consumer Acceptance
Sales Making Advertising
All Signs Point to the D-X Way to Profits
Many advantages go to alert distributors who line up with Mid-Continent Petroleum Corporation.
The complete D-X and Diamond lines include the new aviation-type D-X Motor Oil, and D-X Lubricating Motor Fuel . . . the gasoline that is different!
Investigate the profit possibilities under the exclusive D-X Franchise . . . ask about the availabilities now open.
D-X
MOTOR OIL
D-X
LUBRICATING MOTOR FUEL
"HUNDREDS OF GASOLINES BUT ONLY ONE D-X"
MID-CONTINENT PETROLEUM CORPORATION
WATERLOO, IOWA TERRE HAUTE, IND. TULSA, OKLA. CHICAGO OMAHA

Wholesale parts truck of Nebraska-Iowa Oil Co. (Interior shown above, exterior below) carries 2,000 items for on-the-spot delivery. Salesman works on 'open top' commission; covers 500 miles a week

support, Nebraska-Iowa Oil Co. uses the papers in Dennison, Ia., and Fremont, Neb., regularly the year around. Other county papers are used in the spring and fall and on special occasions. When Mr. Snyder announced his employes' bonus plan, dealers took advertisements in several papers. Product brands were emphasized, but the Nebraska-Iowa Oil Co. bonus for employes was mentioned as indicative of the type of local company supplying the products. Reporters picked up the story and it received columns of publicity, including some in the larger daily papers in Omaha.

Other advertising media used are direct mail blotters, circulars and a good quality of automatic pencils with "Nebr.-Ia. Oil Co." imprint.

What all of these sales methods sum up to in addition to sales volume is the fact that Nebraska-Iowa Oil Co. does not lack for retail outlets. In considering outlets, Mr. Snyder studies each proposed new dealer and his location carefully to make sure that he measures up and that taking him on does not interfere with or decrease the opportunities of his other dealers. Also, there are no split accounts. For example, during this interview, report came to Mr. Snyder that a new dealer was opening a station in one of his towns. He wanted Mr. Snyder to supply him with petroleum products, but proposed to buy his TBA and parts elsewhere. The account was refused after the sales policies of Nebraska-Iowa Oil Co. were explained to him. The dealer came back the next day and asked to join up 100%.

Careful Credit a Sales Tool

Declaring credit a fine tool for securing business, Mr. Snyder said that several years ago when dust storms in parts of Nebraska virtually destroyed farming and farmers could not pay their bills, Nebraska-Iowa Oil Co. had a problem—go strictly cash or obtain secured credit. He worked out a special sales contract in mortgage note form and had farmer customers sign it for varying amounts according to individual ability to pay and needs for the coming year. Amount of each contract was then credited to the customer's open account. Credit department then didn't worry the customer until the amount fixed had been consumed.

"It worked out successfully for us," Mr. Snyder said, "and also paid considerable interest on our credit business."

Good Bookkeeping Key to Success

Financial statements and reports giving a complete picture of operations boiled down to profit and loss are received across the desk of management each month at Blair. In the petroleum business, it was pointed out, it's easy to have put before you every month, an actual inventory of products at each bulk plant and other location so that shrinkage, losses and other things can be carefully checked.

"I don't believe the average jobber has time to keep books himself," Mr. Snyder said. "It is my recommendation that all jobbers, large, small and medium size, have an accountant set them up a simple set of double entry books and hire the best bookkeeper they can find to keep them for him. Then have an outsider come in and teach the jobber how to read his own books unless he has had sufficient schooling to understand them. I actually believe that more jobbers fall by the wayside from lack of knowing what each operation costs them to do business than from any other cause. Being a good jobber is being a good financier. I don't believe it is possible for a man to make very much money in any business unless he borrows money. It is difficult to borrow money from a hard-headed banker unless you have an adequate set of books proving that you know what you're doing, whether you are making a profit or losing money, and from what department and merchandise the profit comes.

"You will want to know whether or not your tank-wagon salesmen are checking in with the right number of gallons in sales," he continued; "whether or not your supplier is beating you on temperature corrections; whether or not your shrinkage is too heavy and why. A jobber who carries all of his bookkeeping around in his hip pocket seldom knows whether or not he is broke. He usually has to cut prices to get business . . ."

It is apparent that Mr. Snyder considers good bookkeeping the key to successful selling as well as management, for he stated in addressing three state jobber conventions during the past year that he would rather lose his salesmanager or salesmen than all of his bookkeeping department.

Pursuing Scarce Items

Rooting out scarce tires, batteries, accessories and small automotive parts on personal trips to the factories is the way to establish steady sources of supply in the opinion of Mr. Snyder. His parts truck and parts department, which handles these items, has been a phenomenal success.

Parts salesman-truck driver works on an "open top" commission basis and makes two 3-day trips each week. Each trip is a virtual sell-out of supplies on the loaded truck and the driver returns with $500 to $600 in sales, most of which is in cash.

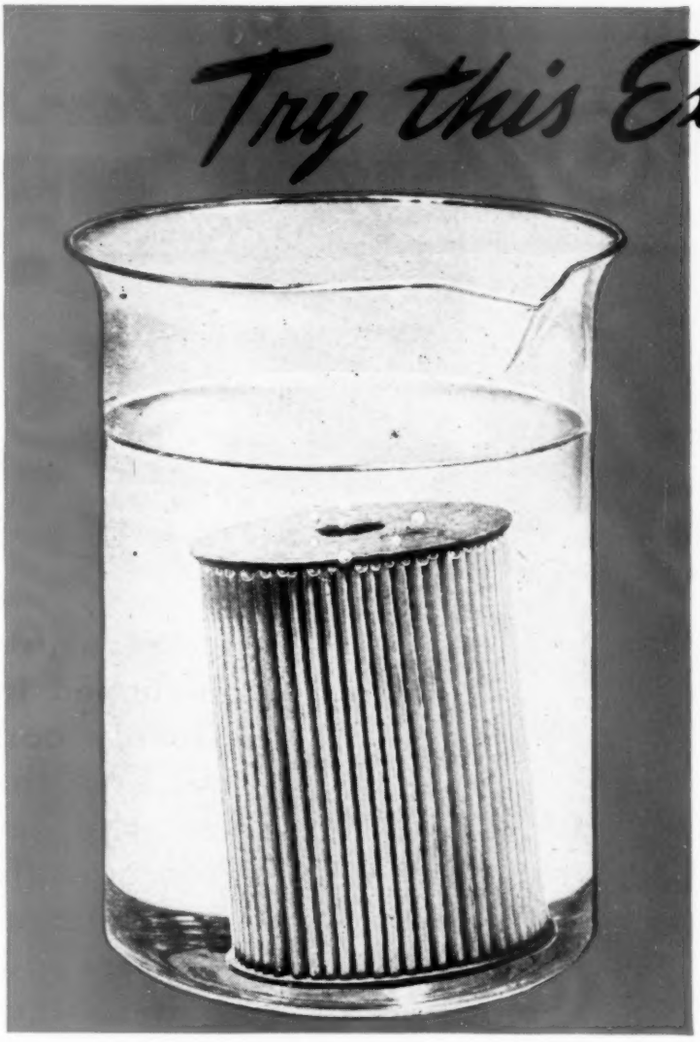
Putting TBA and parts on an equal profit footing—or better—with oil jobbing is not something that can be accomplished in short order, especially with supplies difficult to get; but it can be done, and it is profitable business. Proof of this business pudding is a look at how Mr. Snyder has done it. He found that oil jobbers, at least those in this section of the Midwest who probably are not as large as some in more heavily populated areas, do not command the full respect of manufacturers. Why this is, jobbers can figure out for themselves, but Mr. Snyder said he was very much interested in seeing the situation corrected.

"Do we have jobbers in the real sense here in this part of the Midwest," he asked, "or are they a combination of jobbers and retailers which some manufacturers do not like?"

To illustrate what is meant, he said that when he first engaged in the wholesale parts and accessories business and was looking for supply sources, he naturally wrote to national brand manufacturers of TBA and small parts, since he handled branded petroleum products. Some manufacturers replied that they were adequately taken care of in the area. Others did not reply at all. So Mr. Snyder loaded his wife and son in the family car and went to see the manufacturers personally. It took persuasion to get past the office girl to the president, or even to the salesmanager.

"I then asked them point blank why they took the attitude they did toward me and my company," Mr. Snyder said, "since we had a respectable record in Dun & Bradstreet. They invariably replied that they thought we were 'just another oil jobber from the Middle West'.

"After giving them a good selling



Try this Experiment!

PROVE THE OUTSTANDING SUPERIORITY OF THE PUROLATOR MICRONIC OIL FILTER

Put a PUROLATOR MICRONIC OIL FILTER element in a jar of water. Let it stand for a day and you'll be amazed at the results.

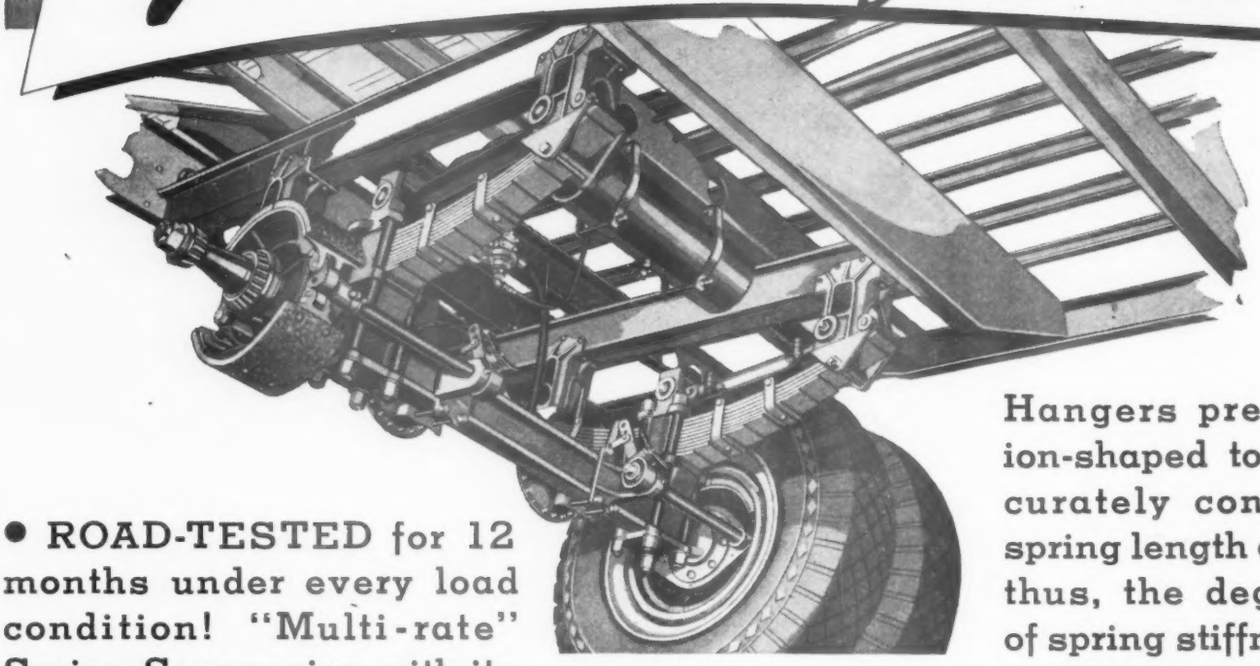
The PUROLATOR MICRONIC OIL FILTER remains unharmed, even when immersed in water for as long as 300 hours!

You may ask why test an oil filter by soaking it in water? Simply because oil in a crankcase is frequently diluted with as much as ten per-cent water. An oil filter *must* be waterproof if it is to function efficiently.

PUROLATOR MICRONIC OIL FILTER

"*The greatest advance in the history of engine protection.*" Radically improved filtering agent actually traps *all* dirt, dust, grime and other harmful abrasives that get into a car's oil right down to the size of a micron (.000039 of an inch). Waterproof, warp-proof element impervious to engine temperatures and crankcase dilutions of oil. Three times more filtering material holds more dirt, gives triple protection to engine. Purolator Products Inc., Newark 2, N. J. In Canada: Purolator Products (Canada) Ltd., Windsor, Ontario.

Fruehauf Single-Axle ... features "MULT-R...



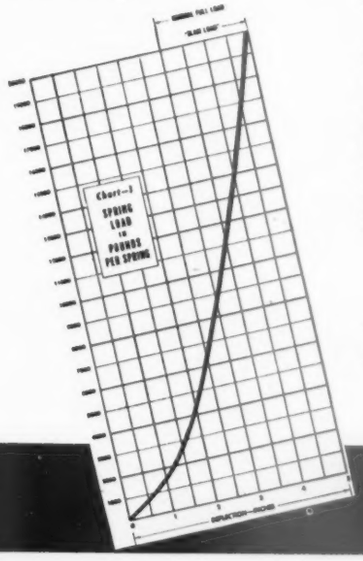
Hangers precision-shaped to accurately control spring length and, thus, the degree of spring stiffness . . self-lubricating, friction-reducing rollers . . horizontal radius-rod mounting . . elimination of helper springs . . patented "tieing" of radius rod direct to axle . . all these result in "Multi-rate" providing a rate of spring stiffness in exactly the correct ratio to the load carried!

From no-load, through the entire range to heavy over-load, "Multi-rate" gives you the right spring action.

• **ROAD-TESTED** for 12 months under every load condition! "Multi-rate" Spring Suspension with its patented features insures perfect springing—provides . . .

- **Increased axle and spring capacity, with no increase in weight—*plus* . . .**
- **An outstanding improvement in Trailer springing.**

"Multi-rate" operates on the so-called "slip-end" spring principle—but there the comparison with this type of design stops.



This graph shows how spring deflection increases in correct ratio to the load.

World's Largest Builders of Truck-Trailers

FRUEHAUF TRAILER CO. • DETROIT 32

8 Factories—62 Factory Service Branches

"ENGINEERED TRANSPORTATION"

Axle Trailer Underconstruction
LTI-RATE" SPRING SUSPENSION

A *"Multi-rate" in light position. Only the ends of the top spring leaf are in action — bearing on two rollers to minimize friction. A 50" spring — a passenger-car ride!*

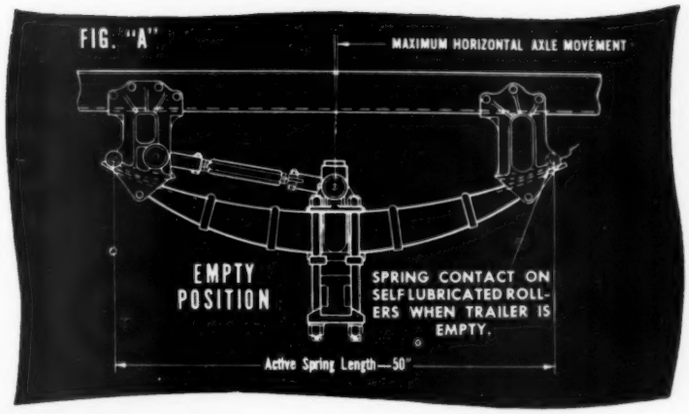
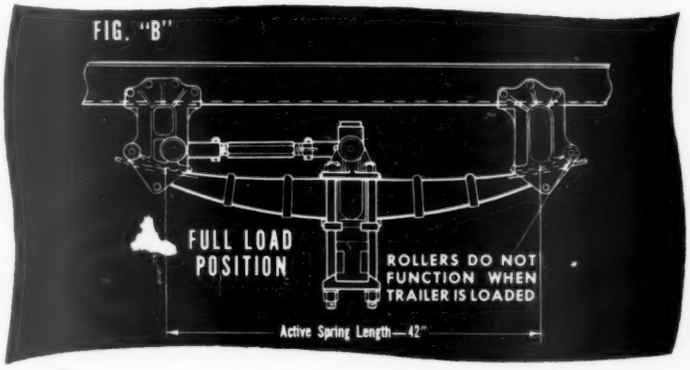
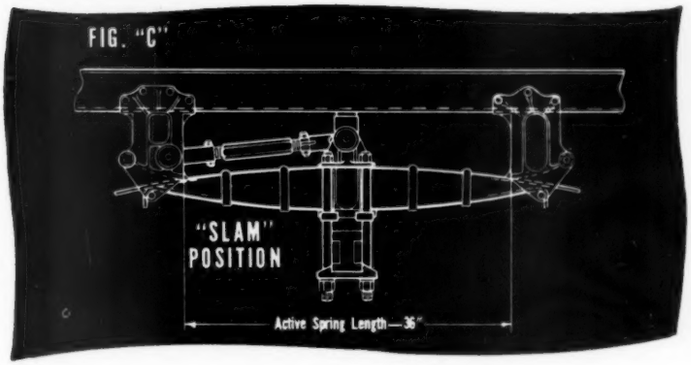


FIG. "A"
MAXIMUM HORIZONTAL AXLE MOVEMENT
EMPTY POSITION
SPRING CONTACT ON SELF LUBRICATED ROLLERS WHEN TRAILER IS EMPTY.
Active Spring Length—50"



B *As soon as load is applied, the spring makes contact with the hangers —and the contact point moves inward, shortening and stiffening the spring, in correct ratio to the increase in load. Note horizontal radius rod.*

C *Here the spring has reached its shortest and stiffest position, the rubber block on top the radius rod contacting the frame. The spring has shortened to 36" active length—a position possible only under shock or the most extreme overload.*



Note how the radius-rod design practically eliminates forward or backward movement of the axle—your further assurance of perfect alignment and maximum spring efficiency.

Send today for fully-illustrated folder telling the complete story of this new idea in Trailer springing.

Fruehauf Trailers

talk on the fact that oil jobbers of today are business men," he continued, "I usually came back home with a contract or permission to sell their merchandise."

This happened before the war and close contacts established have resulted in a continual flow of supplies during the later and present scarcity periods, although the volume is necessarily limited. However, the general attitute of manufacturers toward small oil jobbers out here has not changed. This is evidenced by the fact that when necessary to seek supplies from a new source, the selling job has to be repeated, Mr. Snyder said.

"When in a seller's market," he continued, "success in securing merchandise also depends upon past experience with sources of supply. Are you a close buyer who chiseled ⅛c off the price, changed sources without reason, or forgot to build friendships by scratching the back of your supplier deep enough so that he definitely knew you were a customer?"

Maintenance of prewar service by keeping the parts and accessories truck running throughout the war for on-the-spot sales and deliveries to garages, service stations and repair shops was another contribution to success of the parts department of Nebraska-Iowa Oil Co. During gasoline rationing and the shortage of help, the parts truck saved customers' time. It was the first, or one of the first, operating in this part of the country. To give it a natural parts department appearance, skylights were installed in the roof, or top of the truck, which also was equipped with electric lights and proper entrance steps for convenience of customers. It was specially designed, using a 1½-ton chassis with over-engine cab. The body is 8 x 16 ft., equipped inside with steel parts bins, which hold over 2,000 items. It soon proved itself.

Among items now carried in the truck and parts department sales room are:

B. F. Goodrich tires
Delco batteries and electrical parts
Champion spark plugs
McQuay-Norris motor parts
Gates fan belts
Alemite lube equipment
Quincy air compressors
Joyce hoists and jacks
G. E. lamps and charging equipment
Zerone and Zerex anti-freeze
Chrysler Airtemp furnaces and oil burners
Johnson outboard motors

The outboard motor agency is a new addition, and tractor parts are being considered. The available supply of Chrysler furnaces and burners has been limited, Mr. Snyder said, but they are becoming more plentiful now and it is the intention to drop all other lines which have been handled on a temporary basis.

Asked about other items for the future, reply was that refrigerators, radios and other heavy electrical appliances are not within the usual province of oil jobbing on account of the service required.

"Service stations should handle only such items as a customer can carry home under his arm," Mr. Snyder believes. "They are not ordinarily capable of handling appliances and too much delivery and service burden fall back on the jobber," he said.

However, one thing he thinks might be included are packaged groceries. Say, a dozen cans in a single sack or package—three cans each of corn, peas, tomatoes and beans. They are all staple items and would be sold as a package only. They are not perishable, and would be a convenience for housewives and hurrying husbands, he pointed out.

Sales Incentive Program

Nebraska-Iowa Oil Co. with its nearly $1,000,000 in annual sales is an outgrowth of Mr. Snyder's yen to quit school at the age of 17 and get into the then booming new automobile business, which he did in 1912 at Woodbine, Iowa. He was born there on Sept. 19, 1895, and was about to graduate from normal school when the autobuggy idea hit him.

"My dad gave me $1,000, which I put into a company that we—my brother, C. A. Snyder, and H. A. Farnsworth—formed," he said. "I was the entire sales department at 17, and sold Paige cars. My brother kept the books and Mr. Farnsworth looked after finances. Going broke in 1916 completed my education," he added.

After that came grocery clerking for a few months until drafted for 13 months service in the 4th Division Field Artillery, 16th Battery, World War I. Twelve of the 13 months were spent overseas as a buck private. After discharge, August 19, 1919, Mr. Snyder returned to the automobile business as salesman at Logan, Ia. In 1921, he moved to Blair as a hardware salesman for F. W. Arndt. The Arndt-Snyder Motor Co., through urgings of the junior partner, blossomed out of the Arndt Hardware Co. in 1922, and a Ford agency was taken on.

The agency was sold in October, 1941, and the company was dissolved soon after so Mr. Snyder could devote full time to the oil business, which had made headway since organization in 1926. He bought the interest of a third party, Clark O'Hanlon, which gave him control of the company. He and Mr. Arndt then brought with them to the oil business, the left over parts department of their automobile business. Mr. Arndt, 83, has since fully retired from the business although he is still chairman of the board of Nebraska-Iowa Oil Co. Mr. Snyder is president, his wife, Mrs. Ada P. Snyder, is vice president, and A. W. Johnson, who handles the books, is secretary-treasurer.

The company started off with $100,000 capital in 1926. The amount has since been increased to $150,000—$80,000 common and $70,000 preferred—with $110,000 now paid in and $70,000 more in surplus. Mr. Snyder owns 59% of the common. In the beginning the company handled Marathon products, switched to Shell in 1928, and in 1938 went to Socony-Vacuum when Shell withdrew from marketing in the Central Midwest.

How was the "open top" sales incentive worked out?

A few years ago, one of the company's tank-wagon salesmen in a town of about 1250 population had an exceptionally fine month during the spring season. Mr. Arndt was then president of the company and about 80 years of age. Mr. Snyder was bragging to him about having to pay the salesman between $800 and $900 net money that month for the privilege of selling products handled by the company. In telling the story at jobber conventions, Mr. Snyder said: "'Well, Lee,' he (Mr. Arndt) said to me, 'you are going to take care of that next month aren't you?'

"I looked at him for a moment and said, 'Yes, I am going to write this young man a letter, asking him if it would not be possible for him to increase his sales so his check would be $1,000 next month.' "

It appears that Mr. Arndt did not quite understand and inquired of Mr. Snyder why he wanted to do that. "Well," Mr. Snyder replied, "If this man can sell the merchandise that we have at the prices I give him and he can make $1,000, then I'm sure we are going to get a little bit of the crumbs that fall from those sales. I am glad and willing to pay him on an 'open top' basis."

Mr. Arndt replied: "I believe you young fellows have an idea."

Steady Growth Since 1926

Nebraska-Iowa Oil Co. has had a steady growth since organization on Dec. 26, 1926, as shown by these figures on sales during the past 19 years:

Year	Annual Gross°	Gallons°°
1927	$157,741	.....
1930	163,610	875,676
1935	226,045	1,263,215
1940	387,128	2,591,208
1945	902,476	4,803,489

° Includes petroleum products, accessories and automotive parts.

°° Includes petroleum products only—gasoline, tractor fuel, burning oil lubes and greases.

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OIL PORTRAIT

WALTER S. HALLANAN—

A Leader of the Fight Ag
Temporary Chairman of Nat
President of Plymouth Oil

By HOLGER RIDDER
NPN Staff Writer

● Walter Simms Hallanan likes a scrap.

Statistically he is listed as president of Plymouth Oil Co., Pittsburgh; an executive or director in five other oil companies; married and the father of two children; a former politician and an ex-newspaperman. Wealthy in his own right, belonging to the right clubs and hopping around the countryside on business in a Lockheed Lodestar, the Hallanan geneology doesn't differ outwardly from that of numerous other oil industry executives.

Lately his name has been seen quite frequently in connection with the oil industry's fight to rid itself of the shackles of OPA. That, in itself, is not so unusual either. The names of Holman, Drake, Pew, Wilson, Jennings, Majewski, Hardy, Morrill, and others have appeared just as prominently.

Thus, to the small town jobber in Iowa or Nebraska, Mr. Hallanan may easily be placed in the category of just another oil company official who joined the march against continued government regimentation.

But there is a difference.

Possibly this bit of Hallanan philosophy, expressed in two of his recent speeches, once before the mid-year meeting of directors of Independent Petroleum Assn. of America at Houston in May, and again before the Production Division of American Petroleum Institute at Pittsburgh in mid-June, supplies an inkling to his character and manner of fighting for his principles:

"The Good Book says, 'The wicked flee when no one pursueth. . . .' We accept that in its real Biblical sense. But, my observation has been that they run a lot faster when someone is after them."

When Walter Hallanan was named to the special API committee for oil decontrol he decided to make someone—Messrs. Bowles and Porter by name—flee from the bailiwick of bureaucracy and forthwith began prodding the pursuer—Congress—into action.

The entire oil industry joined in this crusade against bureaucracy. Major company officials, independents, wildcatters, large and small jobbers and marketers—virtually all contributed their part to the battle. But moving in and out of Washington in between fighting talks delivered to any oil men who would listen (and they were many), was Walter Hallanan.

And it was in Washington that the Hallanan technique produced the most telling results.

An ex-newspaper man, Walter Hallanan had the knack of presenting his story in a forthright manner. A politician (both in past practice and at heart), he knew the "angles" in Washington. An oil man, he knew the problems of the industry.

This triple-threat combination resulted in counteracting the maze of arguments tossed at congressmen every day by OPA and its proponents.

Mr. Hallanan wasn't alone in appearing before Congress in the move to inform the nation's lawmakers of what makes the oil industry click and why, under prevailing circumstances, it should be released from the price control regulations of OPA.

But, as one Pittsburgh oil man put it, "Walter knows about half of the members of Congress well enough to call them by their first name. He knew that in

Fight Against OPA Regulation
an of National Petroleum Council
outh Oil Company

order to shake off OPA, the senators and representatives would have to first learn about the oil industry. They had to learn industry's side of the picture. OPA was making sure they knew the government side."

The oil man went on to point out, "Other oil company executives knew oil too but they didn't speak the language of Washington. Their testimony at various hearings was extremely valuable, but for some reason it didn't register too well. But Walter talked their language and the congressmen listened."

What about Mr. Hallanan's version? No one man is responsible for industry's progress against Washington bureaucrats. It was just natural that oil men, big and little, rise up on their hind legs and demand that they be freed of wartime economic chains. The fight had passed the resolutions stage and the arena was set for a rough and tumble, bare-knuckles tussle.

Walter Hallanan set about making speeches aimed at prodding everyone in the industry into action. He talked to all the congressmen he could in Washington. In some cases he even followed legislators when they went on trips, just so he could talk to them and sell them, as it were, on industry's side of the story.

He was campaigning again as he had back in 1913 when he was instrumental in winning for Dr. H. D. Hatfield the governorship of West Virginia. Still a politician at heart, he was once again in a political battle, this time to bounce bureaucrats out of the industry which has made millionaires out of some wildcatters and has been as responsible as any other for advancing the standards of living for all Americans to its present high level.

"My vocabulary isn't too good," he says, but he lacks little in the ability of expressing his beliefs. Take this excerpt from his speech in Pittsburgh recently:

"In order to be an American, you first must believe in America and in the things that it stands for. You must have pride in your soul and gratitude in your heart for the system of government which has produced more wealth and more happiness, more freedom, higher living standards, greater opportunities, higher wages and better working conditions than have ever been enjoyed by any other people on the face of the earth at any time or at any place in all the history of the world.

"The real test of Americanism lies not alone in whether we believe in the freedom of the individual citizen but whether we are willing to fight to maintain that freedom. When I say freedom, I mean freedom from the oppression of big labor, big business, big government, or big anything. I don't care what you call the thing that proscribes the liberties of the people, I brand it as un-American and totalitarian."

What then, is the background of this man who has mixed newspaper work, politics and oil and come up with a formula which has made him a millionaire, but one who would rather get into a hot political battle than sit back and clip coupons?

Possibly Michael Late Benedum, wildcatter and one of the organizers of Plymouth Oil, has instilled in Mr. Hallanan some of the spirit of the inveterate wildcatter—the urge to be constantly on the go and to get things done.

Whatever may have been the predominating influence in his life, oil entered into the course of events early in his youth.

Walter Hallanan was born in Huntington, W. Va., April 29, 1890. That was the year of the oil boom in Parkersburg, up the Ohio River from Huntington and the spot where Mike Benedum that same year received his petroleum christening under the hand of John Worthington, head of the land-and-lease department of South Penn Oil Co., the Standard Oil Trust's important eastern producing subsidiary. It was not until 33 years later that the Benedum and Hallanan paths crossed to father the birth of Plymouth Oil. But more about that later.

Walter's father was Thomas Hallanan, M. D., a country doctor. A newspaperman at heart, Thomas Hallanan relinquished his writing career to study and later practice medicine as the result of having promised his mother on her deathbed that he would heed her wishes.

In his early teens Walter was wont to accompany his father in horse and buggy as he made his rounds of patients in Huntington and vicinity. But while Thomas Hallanan cared for the sick, he maintained his urge to write and found an outlet by writing letters to the editor of the Huntington paper. And quite often the doctor would stop in at the office of the Huntington Dispatch and

Tribute to a Country Doctor

Gracing the desk of Walter Hallanan in his Pittsburgh office is a gold frame containing a reproduction of a tribute written to his father, Dr. Thomas Hallanan. He is very proud of that tribute in a quiet and sentimental sort of way.

The reason is obvious. Dated Oct. 16, 1921, the tribute reads in part:

"Master of Men, Brother of Men, Old Pal of Men, Dr. Thomas Hallanan, friend and helper of men, left us Saturday morning while the skies were still dark and our eyelids were too heavy with sleep to see the ship set sail and leave our shores. You take care of him now. We needed him, but we wore him out. Put your eternal arms under his tired spirit. If the boat rocks across the dark waters, Master, move up closer to him. Let his ship finally moor where the shores are gold and the Elysian fields reach down to drink. Let the harps play a little when he gets to the gate. He loved music. Throw out your wireless and tell the boys who have gone before—the hundreds whom he befriended—to come down to the landing and lead the procession up to the Fountain where he can get a drink that will make him young again.

"Master, forgive Dr. Thomas Hallanan, and forgive us. Look at the good that was in him. It was gold. Wash away whatever grime was on that gold. The earth is not good to men. Men give their gold and get the grime. The earth is torn with shot and shell—and hell. Master, the wounded are coming up to You . . ."

The author of the tribute was not a man of letters.

"He was the postmaster of Barboursville, W. Va., and a friend of Dad's," said Mr. Hallanan, replacing the frame on his desk.

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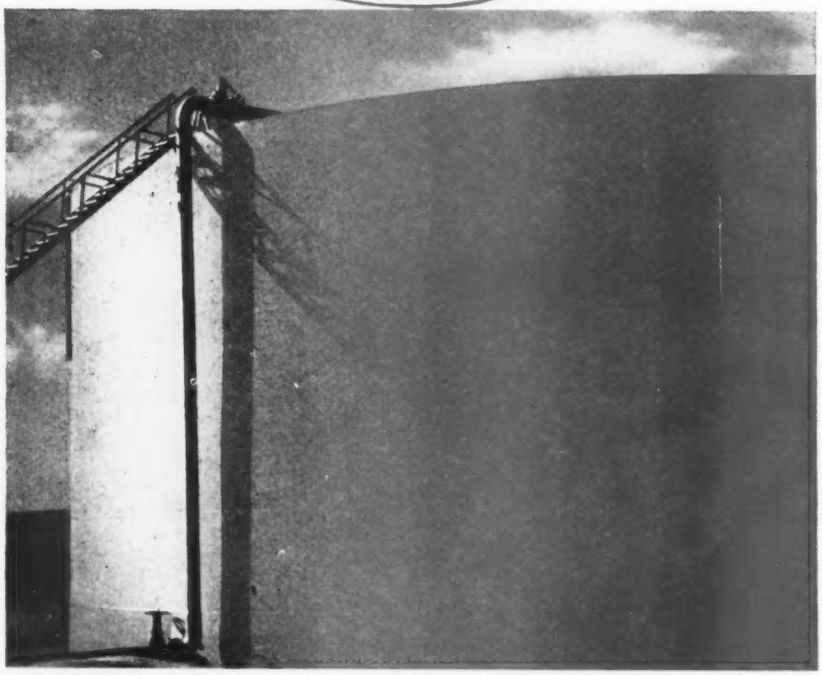

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talk with the boys in the city room. These visits gave Walter the smell of printers' ink.

An uncle, Walter A. Hallanan, prominent Dayton, O., attorney, wanted Walter to study law. The doctor expressed no particular preference as to his son's career, and it was more or less accepted that Walter would choose the profession of law.

Gives Up Plan to Study Law

But young Hallanan succumbed to the urge to become a newspaperman, a move which his father probably inwardly approved, though he isn't on record as having expressed any opinion one way or another. So, in 1908, while still in his teens, he began as a cub reporter for the Huntington Dispatch.

In 1909 the two Huntington papers, the Dispatch and Herald, were merged to form the Herald-Dispatch. With only a year's experience to show, young Hallanan was promptly ensconced in the managing editor's chair where he remained for four years.

Today Mr. Hallanan looks back at his five years of newspaper work much as others might regard their college days.

"It was a rough and tumble business and it showed me the seamy side of life. It taught me responsibilities and I consider my training there as worthwhile as four years of college," he said when interviewed in the paneled directors' room of the Plymouth offices in the Benedum-Trees Bldg. in Pittsburgh.

Young Hallanan's newspaper career was rather shortlived as careers go. Politics entered into the picture.

Dr. Henry D. Hatfield, a surgeon, was nominated Republican candidate for the governorship of West Virginia in 1913. Young Hallanan, like his father, was a Republican. So, when the West Virginia State Republican Committee suggested that Walter Hallanan handle Dr. Hatfield's publicity, it wasn't difficult for him to accept the post without qualms—and with considerable enthusiasm.

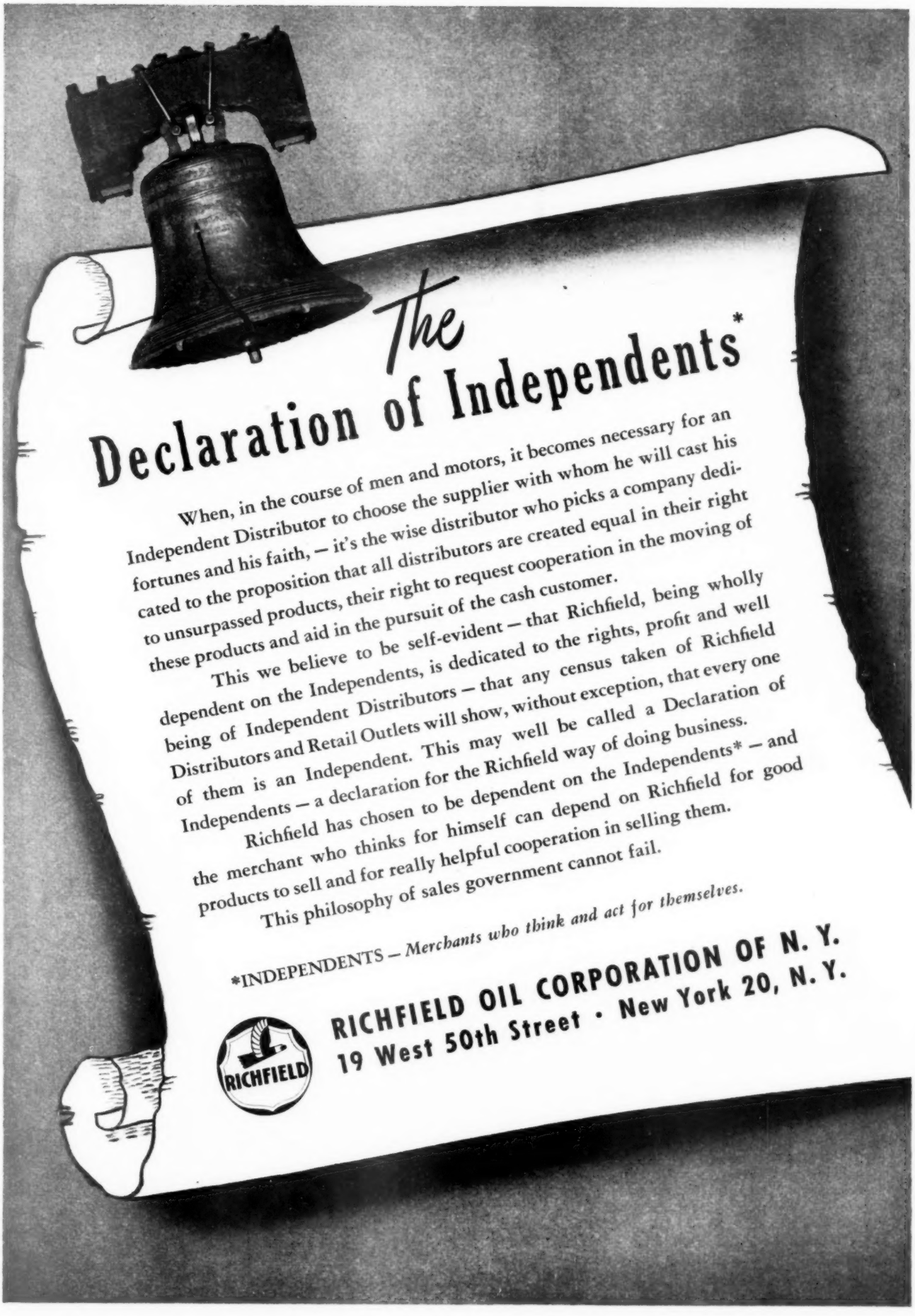
Conducts Successful Campaign

Plunging into his task, one of the first things he did was coin a phrase which swept Dr. Hatfield into office, one of the few Republican governors elected throughout the nation that year. The Hallanan slogan for his candidate was:

"Unbossed, unbought and unafraid."

Gov. Hatfield must have been more than just satisfied with the campaign work of the young editor, for when he took office he offered Walter the position of private secretary to the governor, and in the same breath brought to an end a promising newspaper career. But now Walter was gaining his stride and bigger things loomed ahead.

Dr. Hatfield's term as governor was drawing to a close in 1917 when he pushed through the legislature a measure which provided that persons in ap-


the
Declaration of Independents*
When, in the course of men and motors, it becomes necessary for an Independent Distributor to choose the supplier with whom he will cast his fortunes and his faith, — it's the wise distributor who picks a company dedicated to the proposition that all distributors are created equal in their right to unsurpassed products, their right to request cooperation in the moving of these products and aid in the pursuit of the cash customer.
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pointive offices serve a four-year span before they could be replaced by a new appointee due to a change in administration. Then the doctor surprised young Hallanan by naming him tax commissioner. Thus, when the next governor, a Democrat, came into office he found quite a few Republicans already firmly established in the executive family.

"It was a surprise to me," Mr. Hallanan says today. "And the job kept me busy. I worked nights at the office developing progressive legislation and trying to keep the administration progressive. My duties involved various tax measures as well as matters pertaining to utilities and a sideline of enforcing prohibition laws."

For six years he was tax commissioner. During that period, in the course of his duties as tax commissioner, he came into contact with numerous oil men and he began to display more than a passing interest in the intriguing business of exploring the depths of the earth for "black gold." And it was during this time that Mike Benedum was hitting a fast pace as a wildcatter.

It was while working for South Penn in Parkersburg, W. Va., that Mike met Joe Trees, son of a small-town Pennsylvania mill owner, who later became Mike's partner in what was to develop into a grandiose wildcatting venture that defied equal.

This was in 1897 that Benedum and Trees met. Joe Trees was an engineer with South Penn but he soon broke the bonds of employment and, with $100 borrowed from Mike, set himself up in the lease business. A well had been brought in at a place called Whiskey Run and Joe Trees tried to buy a piece of oil royalty. He located a prospect but, not having the ready cash (about $2,000), he turned again to Mike for a loan.

Mike Benedum put up the cash, with the stipulation that he be given a seven-eighth interest in the half interest in the farmer's one-eighth interest in the oil from the well, which was yet to be drilled. The well came in strong and in 30 days was netting Mike Benedum and Joe Trees from $1,500 to $2,000 a month. The Benedum-Trees wildcatting venture was on its way.

Legally, the Benedum-Trees partnership was not formed until 1900 when Mike left South Penn.

Hallanan and Benedum Meet

From West Virginia the Benedum-Trees duo moved to the Casey field of Illinois—their first big operation. Next came Oklahoma and then Louisiana, the Caddo field near Oil City, La., and in quick succession Mexico and Texas. And it was in 1923 that Walter Hallanan and Mike Benedum met and formed the Plymouth Oil Co.

Mr. Hallanan, still West Virginia tax commissioner, was at White Sulphur Springs with former Gov. Lowden of Illinois as his guest. Mike Benedum also was on hand.

As told by Mr. Hallanan, it appears there was a Texan from El Paso by the name of Frank Pickrell. An ex-soda jerker, after World War I he had become chummy with a friend who had an option on a stretch of barren West Texas range land owned by the University of Texas. But Pickrell lacked the cash to drill the wells required to validate the leases.

Pickrell had spudded a well, the Santa Rita No. 1, in this drab stretch which had been tagged "the wildcatter's graveyard" and which was scorned by geologists as being practically worthless. After two years of drilling he finally brought in the Permian Basin. It wasn't an impressive well and averaged only 100 b/d.

Looking around for capital to drill the wells required to hang on to his other leases, Pickrell met Jerry Farquhar, one of Mike Benedum's men. When Mike met Pickrell he took a liking to the man and decided to make a deal. But Joe Trees, Mike's partner, was dubious and wanted no part of the deal. So Mike went ahead on his own.

The Benedum proposition called for 10,240 acres in the middle of the 50,000-acre block where Santa Rita came in and in return eight wells would be drilled, costing $50,000 each, enabling Pickrell to "prove up" his option on the remaining acreage.

It was here Big Lake Co., in which Pickrell had a quarter interest, found its beginning. As a holding company for his three-quarter interest, Mike Benedum formed the Plymouth Oil Co., capitalized at $5 million represented by one million shares of common, which Benedum divided into 81,000-share blocks among such business cronies as Levi Smith, Farquhar, T. R. Cowell and Hallanan, who helped to raise capital for the venture in his home state.

Hallanan Heads Plymouth Oil

Walter Hallanan quit his job as tax commissioner and became president of Plymouth Oil. Big Lake went ahead with its drilling program and in June, 1924, No. 9 well came in with 1,500 bbls. That made the Permian Basin of West Texas, saved the $750,000 Mike Benedum advanced Plymouth before No. 9 gushed, and sent Walter Hallanan on his way to the top in the oil industry.

When he became Plymouth president, Hallanan had only a smattering of knowledge of oil. "Certainly not a working knowledge," he says. But he learned fast and fared well. And Plymouth Oil rolled smoothly along. In its first 10 years, before it ventured much into other fields, Plymouth earned $24 million from its three-quarter cut of Big Lake and of this $4,375,000 in dividends went to Mike Benedum.

Today Walter Hallanan, in addition to being president of Plymouth, is a director of Republic Oil Refining Co.; vice president of Republic Pipe Line Co.; vice president of Duval Pipe Line Co.; and director of Arkansas Natural Gas Co. and Arkansas Pipe Line Co. All are ventures in which Mike Benedum had a part in forming as a result of his wildcatting ventures and shrewd trading.

During the war Mr. Hallanan was a member of PIWC; general chairman of the production group of PIWC; chairman of the Production Committee of District 1, PAW; a member of the committee API created to present oil's opposition to OPA controls; vice president of Independent Petroleum Assn. of America, and latest, temporary chairman of National Petroleum Council.

Married and the father of two children, Walter S., Jr., 24, and Elizabeth Virginia, 21, Mr. Hallanan still calls Huntington his home and maintains his residence there. However, during recent months as a result of his speech-making, trips to Washington to convert congressmen to industry's way of thinking, and tending to his duties as Plymouth president, he has been spending most of his time away from home. When interviewed at his Pittsburgh office he was preparing to depart the next day for Huntington to see his family at home for the first time in several weeks.

Because his schedule is so full, he usually flies in the Lockheed Lodestar which Plymouth operates out of the Pittsburgh base.

Asked if he found any time for a hobby, Mr. Hallanan grinned.

"I guess you might say it was politics. I have never lost that interest."

In 1926 he was elected to the State Senate in Charleston, W. Va., and for four years was chairman of the finance committee of the Senate. In 1928 he was elected a member of the Republican National Committee from West Virginia. Then in 1940 he was made vice chairman of the GOP Committee when Willkie was nominated.

And he maintains a close tab on events in Washington. The day this writer talked to him Senate was voting on the Thomas amendment to the OPA extension bill. Several times the interview was interrupted when Mr. Hallanan was called to the phone to get a firsthand report on the progress of the entire bill in Senate.

His views on the future of the independent oil man?

"If he can get his freedom back he will enjoy the same opportunities he has always enjoyed in the industry. If he is tied down by government regulations, he is doomed. Government regulation is a road leading to monopoly. The trend toward government regulation was clear during the war. The fight must be carried on. We must win freedom if we are to maintain the independent's place in industry."

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Performance Counts

Ohio Assn. Counsel Analyzes Effect Of Wage Decisions on Oil Jobbers

Special to NPN

COLUMBUS, O.—Application of the federal wage and hour law to petroleum jobbers and retailers has been somewhat hazy for some time. Recent decisions of U. S. Supreme Court have raised new questions bearing on the extent to which provisions of the statute apply to the employes of jobbers and retailers of petroleum products.

Hubert Fuller, general counsel of Ohio Petroleum Marketers Assn., Inc., has prepared a discussion of the subject which was printed in OPMA Bulletin. This is what Mr. Fuller says:

In several cases the United States Supreme Court has held that the provisions of the law apply to employes engaged in any occupation necessary to the production or manufacture of goods which are to be transported to another state. Recently, the Supreme Court has held that the act covers the employes of a local electrical contractor who does wiring and electrical work and who repairs motors for customers engaged in manufacturing goods which are intended for shipment to another state. In another case, it was held that mechanics engaged in greasing, repairing, servicing and maintaining automobile equipment employed in transportation between states are subject to the provisions of the federal wage and hour law as to minimum hourly rates of pay and overtime compensation for time worked in excess of 40 hours per week.

Many 'Outsiders' Come Under Law

In other cases, the Supreme Court has held that elevator operators and other employes of an office building occupied as the main office of a company engaged in manufacturing products in another state are subject to the provisions of the federal wage and hour law; that watchmen and fire guards of plants engaged in such manufacturing are also subject to that law, and that the act covers employes of a window cleaning company which cleaned the windows of industrial plants engaged in the manufacture of goods shipped to other states. These decisions were based on the assertion that the work done by such employes is necessary to the production of goods which are to be transported and sold in interstate commerce.

In recent decisions the Supreme Court has also declared that the exemption from statutory provisions of "any employe engaged in any retail or service establishment the greater part of whose selling or servicing is in intrastate commerce" applies to "employes of *only such* retail or service establishments as are comparable to the local merchant, corner grocer or *filling station operator* who sells to or serves ultimate consumers who are at the end of, or beyond, that 'flow of goods in commerce' which it is the purpose of the act to reach." The court declared that it was not the intent of Congress under that provision to exempt "other than the local merchants of the type dealing with the ultimate consumer."

The Wage and Hour Division, by Interpretative Bulletin No. 6, declares that the exemption of employes "was intended to apply typically to the grocery store, butcher shop, haberdashery, clothing store, *filling station*, beauty parlor, hotel and similar commonly recognized retail and service establishments." A retail sale is defined by the same Bulletin as "a sale of goods for direct consumption and not for purposes of resale or redistribution in any form."

Defines 'Retail' and 'Service'

So, in a recent decision, the Supreme Court has declared that "the word 'retail' is restricted to sales made in small quantities to ultimate consumers to meet personal rather than commercial and industrial uses of those articles" and similarly that the word "service" is restricted "to services to ultimate users of them for personal rather than commercial purposes."

The court pointed out that customers who purchase articles or service for use in the act of interstate transportation or in the manufacture or production of goods to be ultimately used or sold in interstate commerce "are not 'retail' customers in the same sense as is the customer of the local merchant, local grocer *or filling station operator* who buys for his own personal consumption." Further, the court said: "There never was an intent expressed to exempt retailers other than the local merchants of the type dealing with the ultimate consumer." The court, however, pointed out that such retail establishments are exempt from the provisions of the law even though their sales to consumers may be across state lines.

From these decisions, it follows that the sales at service stations to, or greasing or other types of services there rendered for, customers such as commercial *trucking* companies, *contract haulers* or *commercial accounts engaged in interstate* operations or engaged in the manufacture, handling or production of goods to be sold in other states are *not to be regarded as retail sales*.

The law provides for the exemption from its provision of employes of any retail or service establishment "the greater part of whose selling or servicing is in intrastate commerce." Obviously the words "greater part" mean more than one-half. But the Wage and Hour Division, in the manner characteristic of administrative officials, expands the language of the law by declaring that the exemption applies only to outlets 75% or more of whose sales are at retail. Therefore, in determining whether a service station is a retail establishment whose employes are exempt from the wage and hour provisions of the act under either the language of the law or the language of the administrative interpretation, *employers should include* as retail sales or services only those made to or performed for the individual consumer and should not regard as retail sales or services those to or for commercial customers of the type indicated above or trucking concerns operating across state lines.

Segregation of Employes Is Difficult

Greater difficulty arises in segregating the operations of jobbers between those as to which of their employes are covered by the law and those as to which of their employes are not so covered. A federal court in Minnesota has recently held that the wage and hour law applies to the operations of a jobber or wholesaler who receives petroleum products refined in another state even though *his operations* are wholly within the state in which he is located. This decision, in our opinion, is contrary to the weight of authority. The Supreme Court has held that where gasoline is brought into a state from another state the interstate commerce ends when the gasoline is delivered into the bulk plant located in the state of destination and any further movement is in intrastate commerce except where gasoline is imported to fill a specific previous order. We believe that when gasoline or other petroleum products are emptied into the storage tanks of a jobber or delivered into the jobber's warehouse and mingled with the products already stored there interstate commerce has ended and the movement from that point within a single state in intrastate commerce and employes so engaged are not subject to the provisions of the wage and hour law.

However, we believe that employes, for example, *who unload* the contents of the cars or barges or tankers coming from another state and *keep records* thereof are engaged in interstate commerce and are, therefore, subject to the provisions of the wage and hour law. And we believe that employes engaged in delivering such products to purchasers who use them in the process of producing or manufacturing or handling goods for sale in other states are subject to the provisions of the wage and hour law. So, where an employe operates a tank wagon delivering fuel oil from a bulk plant to a private residence, we have a retail sale and the employe is exempt from the provisions of the act, but where the fuel oil is delivered to a manufacturing plant engaged in producing goods for sale in another state, then that employe comes within the provisions of the act. Deliveries across state lines are

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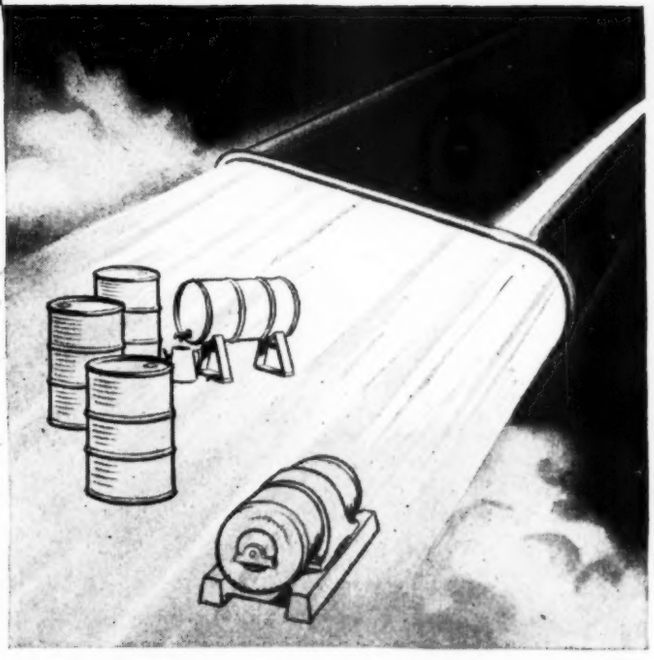

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obviously within the law no matter to whom made.

Tank wagon deliveries to farmers within the same state are retail sales since the farmer is a consumer and the transaction is also intrastate commerce. Tank wagon drivers making sales on a commission basis are outside salesmen or are making retail sales and so are exempted from the act in either case. Deliveries from a *bulk plant to a service station* within the same state are not retail sales but they are *intrastate* operations and therefore, in our opinion, do not come within the coverage of the wage and hour law.

Power Oil Co. Wage-Hour Verdict Seen As Encouraging to Petroleum Jobbers

By FRANK C. STURTEVANT, NPN Staff Writer

Application of the federal wage-hour law to service station employes has been discussed by Mr. Fuller in the preceding article. Oil jobbers have also been concerned with the application of the law to their wholesale employes, and a new decision in favor of an oil jobber has just been rendered in South Carolina. (See NPN, June 26, p. 6).

This jobber, Power Oil Co., of Orangeburg, S. C., secured all of its gasoline and other fuels from marine and pipeline terminals located within the state, and it was agreed by the wage-hour attorneys that this was not interstate commerce. However, 20% of the company's business consisted of tires, batteries, accessories and motor oil purchased outside the state and shipped into its warehouse at Orangeburg.

The court decided the goods ceased to flow in interstate commerce upon arrival at the warehouse. Since the Power Oil Co. methods of operation parallel those of a great many oil jobbers, the reasoning upon which the court based its decision should have a wide application.

Interstate Commerce Is the Hook

Before looking at the decision, however, it should be borne in mind that the federal government can regulate wages, hours and all other conditions affecting interstate commerce. Increasingly in modern times our federal government has made interstate commerce the hook on which to hang all sorts of far reaching regulations.

Most wage-hour cases therefore boil down to a question of whether the company being sued is doing an interstate business.

In 1943 the U. S. Supreme Court decided two leading cases on this question, both involving jobbers in other lines of business. In the Jacksonville paper case, which was decided against a jobber, the court held that: "Goods came in destined for consumers already selected, and although there was a physical temporary detention at the warehouse, nevertheless there was no real mixing of the goods with other goods and no cessation of the interstate flow."

In the Carr Brothers case a Maine court held that ". . . the goods were actually delivered and stored at the warehouse; and though there may have been prior orders and a ready and quick market, nevertheless, there was no direct movement of any particular goods from the producer to the consumer, nor were any of the goods particularly so designated."

The Carr Brothers case was cited by Judge J. W. Waring in the South Carolina Federal District Court, as presenting a set of circumstances similar to those involved in the Power Oil Co. case. Said the judge: "There was no guarantee that any specific customers were going to buy any specific goods. Because the goods move so fast that they rarely spend more than a day or two in the warehouse does not mean that they are flowing directly to any designated customers."

Judgment was therefore rendered in favor of the Power Oil Co. What this amounted to was a dismissal of the case. The wage-hour administrator had asked for an injunction which would have compelled the jobber to keep payroll records and pay overtime in the manner prescribed by the Federal Fair Labor Standards Act.

Now that the Wage-Hour Administration has lost a case against an oil jobber, the question will immediately arise with all other oil jobbers as to whether the whole question can now be considered settled. This could hardly be so, if for no other reason than the fact that federal bureau jobs are at stake.

Not Their Money

The administration can file as many suits as it likes. The enforcement officials are not spending their own money, and the judges cannot very well throw the cases out of court, as long as each presents a sufficiently different set of circumstances.

And in sober truth it might be better all around if oil men could have more judicial decisions for guidance. It must be admitted that no matter how troublesome law suits may be, they do result in court decisions which are preferable to the conflicting, capricious regulations and interpretations issued by government bureaus and administrators.

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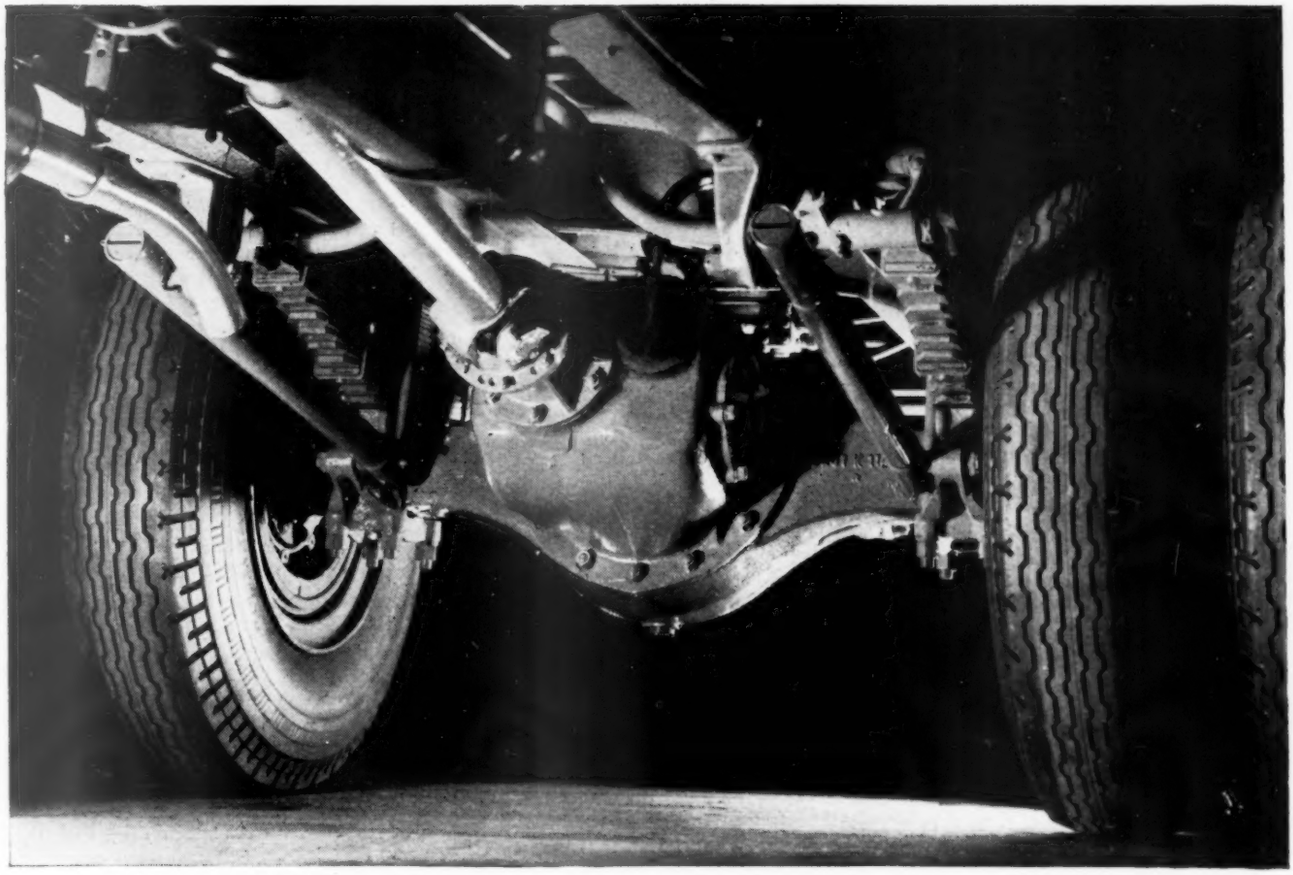

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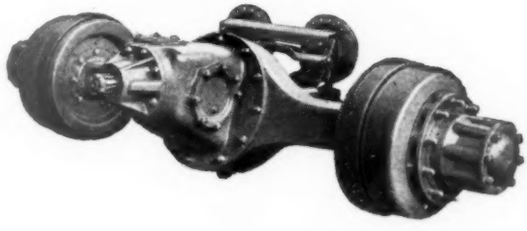

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Refinery Workers' Output per Manhour Skids to 7-Year Low; Unit Costs Soar

Bureau of Labor Statistics Report Shows 1944 as Only Exception in Steady Drop of Employes' Productivity

By Daniel L. Harbour
NPN Staff Writer

WASHINGTON—Productivity of petroleum refining workers in 1945 hit its lowest level in seven years.

The Bureau of Labor Statistics has issued a preliminary report which shows that refinery workers during the period 1939-45 reached their productive peak in 1941 but since then output per manhour has declined steadily, except for 1944 when a small gain was noted.

Using 1939 as its base year, BLS reports that output per manhour last year for 91,700 refinery employes was 6% below base year productivity despite increased unit labor costs of 43.7% in the seven years.

BLS offers no explanation for the downward trend in productivity, asserting its output per manhour figure is not conclusive evidence that employes are working less efficiently than they did in 1939.

Several things in addition to laborloafing could have caused the drop in productivity, a BLS statistician contends. Some of them are efficiency of plant equipment, plant production rates (whether a plant was using all of its productivity capacity in 1945 in relation to the percentage used in 1939), number of personnel doing maintenance and not productive work, efficiency of management, present number of working hours per week, and effects of strikes.

In 1945 refinery workers put in an average of 45.9 hours per week in comparison with an average work-week of 36.1 hours in 1939. This increase in number of working hours each week bears out claims of some labor economists that productivity goes down when working hours go above a level of 40 per week.

The table at the right has been published by BLS in its report on petroleum refining workers.

In explanation of its statistics, expressed as index figures but which can be interpreted in most instances as percentages because 100 was selected as the base index for the base year, BLS gives this breakdown:

PRODUCTION—This index figure is derived from Bureau of Mines production data on seven products: aviation gasoline of 100 octane rating or higher, other aviation gasoline, other gasoline, distillate fuel oil, residual fuel oil, kerosine, and lubricating oil. The production figures for each of the seven years are determined by considering yearly production of the seven products at 1943 average prices. For instance, 1939 production of the seven products was determined by multiplying output of each product by its average price in 1943. These dollar and cents figures for all seven products are added to determine total 1939 production. Latter figure is given an index number of 100. Production figures for each of the other years are calculated in same manner, still using 1943 prices, and the index figure is then determined by comparing the dollars and cents production of each year with the dollars and cents production of the base year. Dollars and cents production of the seven items for 1945 were 50.9% higher than production in 1939. Thus 1945 production index is 150.9. For its calculations, BLS said it obtained following average 1943 prices, in cents per gallon, from OPA: aviation gasoline of 100 octane and higher, 14.69c; other aviation gasoline, 9c; other gasoline, 6.35c; kerosine, 4.59c; distillate fuel oil, 4.27c; residual fuel oil, 2.44c; lubricating oils, 16.14c.

TOTAL WAGE EARNERS—Data for this column is obtained from industry reports to BLS. In 1939 the index number of 100 represents 72,800 workers while the 1945 index of 125.8 stands for 91,700 employes.

TOTAL MANHOURS — Calculations to determine these indices also are based on industry reports received by BLS. The index figures for this column, manhours and payrolls were adjusted for the years 1942-44, from data supplied by PAW, to exclude construction workers. To arrive at total manhours for a particular year, BLS took the figure for number of workers and multiplied it by average weekly hours. This sum then was multiplied by 52 to get yearly manhours. The total was compared with 1939 figures (with construction worker adjustments made for 1942-44) and an index figure determined.

OUTPUT PER WAGE EARNER—Index figure for this item is calculated by dividing the production index of a particular year by the total wage earners index for the same year. For instance, dividing the 1945 production index of 150.9 is divided by the index of 125.8 for total wage earners to give an index of 120.0 for output per wage earner.

OUTPUT PER MANHOUR—Perhaps the most important item of all, the productivity for each hour worked by refinery employes, is determined by dividing the production index for a certain year by the index for total manhours during that same period.

PAYROLLS—The total amount of wages paid during a year is determined by industry reports to BLS and then totals for each year are compared with the 1939 total of $128,214,000 for indices in subsequent years.

UNIT LABOR COSTS—Determination of this index figure for a particular year is made by dividing the payroll index for that year by the production index for the same year.

For an overall picture of refinery labor during 1945, BLS shows, in comparison with 1944, that production, total wage earners, total manhours worked, payrolls and unit labor costs were up but output per manhour and output per wage earner were both down.

BLS statistics prior to 1939 use a base year of 1929 and thus cannot be readily compared with the present report.

Natural Gasoline Consumption For May Exceeds April Figure

NPN News Bureau

TULSA—Production of Midcontinent and Gulf Coast natural gasoline during May total 143,671,569 gals., over April production by 4,992,513 gals. and 3,120,611 gals. under May, 1945, on Grade 26-70 basis, according to report of Natural Gasoline Assn. of America.

Of the total Texas produced 91,146,830 gals.; Oklahoma, 23,779,368; Louisiana, 9,327,572; New Mexico, 5,706,533; Kansas, 5,449,668; Illinois, 4,289,892; Arkansas, 3,971,706.

Table Published by Bureau of Labor Statistics in Report on Petroleum Refinery Workers. Conditions in 1939 Used as Base Index of 100

Year	Production	Total Wage Earners	Total Manhours	Output per Wage Earner	Output per Manhour	Payrolls	Unit Labor Cost
1939	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1940	103.2	100.3	100.3	102.9	102.9	100.9	97.8
1941	113.5	102.8	105.4	110.4	107.7	113.2	99.7
1942	108.4	98.6	106.8	109.9	101.5	125.8	116.1
1943	118.0	101.6	125.2	116.1	94.2	158.3	134.2
1944	146.9	119.1	153.7	123.3	95.6	203.2	138.3
1945	150.9	125.8	160.6	120.0	94.0	216.8	143.7

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ICC Examiner Cites Rebate 'Opportunity' In Oil Trucking Case

NPN News Bureau

WASHINGTON—The Interstate Commerce Commission has received examiner's recommendation that two applications by Jacob Niederhaus, Inc., of Lincoln, Nebr., for extension of petroleum trucking routes in Iowa and Nebraska be denied.

Trucking company has sought to extend routes as contract carrier from Carter Lake, Ia., and Omaha to points in Iowa and as common carrier from Council Bluffs, Ia., to points in Nebraska. Examiner recommended that in view of permits already held by Niederhaus, authority should not be granted because such action would be inconsistent with national transportation policy.

May Be Need for Service

"Although there may be need for applicant's proposed service, or portion of it, if authority sought herein was granted, applicant would be in position to serve same shippers or consignees both as a common and contract carrier," examiner asserted.

"Mere fact that shipments transported as contract carrier might move from a different origin than those transported as common carrier would not remove opportunity for discrimination.

"Unlawful common-carrier practices in nature of rebates could be effected through services performed as a contract carrier where same shipper or consignee also is served as a common carrier."

For example, he said, applicant now serves Phillips Petroleum Co. as contract carrier from certain Kansas points to certain Nebraska points, and, under proposed operations, also would serve Phillips as common carrier.

Examiner stated federal laws "provide in effect" that no trucker shall at same time hold both common and contract carrier permits for same territory unless ICC finds "good cause" for such operation.

Supported Petition

Supporting Niederhaus petitions were Continental Oil Co., Phillips Petroleum and a Lincoln distributor. Latter handles about 4 million gal. of petroleum products per year, examiner declared, and supported applicant on grounds motor carrier service is faster than rail service for his needs and that by using trucks he is able to obtain less than carload shipments.

Examiner added that Phillips sold about 56 million gal. of petroleum products in Nebraska in 1945 and 50% of which moved by rail, and had about 75 jobbers in Nebraska territory included in applications.

In another case, same examiner recommended that Howerter Transport Service of Cozad, Nebr., be allowed to extend routes as common carrier of petroleum products from Council Bluffs, Ia., and all refining and distributing points in Kansas to points in 23 Nebraska counties.

Coal Interests Fight Use of 'Inch' Lines for Natural Gas

NPN News Bureau

WASHINGTON—Fears that use of war emergency pipelines for transportation of natural gas to northeastern U.S. would disrupt nation's coal industry were expressed last week at FPC's natural gas investigation hearing.

No comment was made by commission, which has maintained discreet silence on two FPC applications now pending for conversion of lines for natural gas transmission.

Witnesses for Anthracite Coal Institute contended that supply of 75-billion cubic feet of natural gas annually to metropolitan areas of New York City, Philadelphia, Trenton and Wilmington would displace 7,758 workers. Institute asserted that 75.9% of entire anthracite output is consumed in New York, Pennsylvania and New Jersey.

Attorneys for Natural Gas Industry Committee drew from a coal company witness, who expressed concern over possibility that inch lines would be used to bring natural gas to Philadelphia, that such gas would be mixed with gas manufactured from coal and this mixture would sell at prices attracting greater gas consumption.

NGIC attorney also brought out that one oil company is spending 15-million dollars per year on research in gasification of coal while coal interests are spending only about 2-million dollars per year.

Meanwhile, NGIC indicated tremendous scope of postwar plans of natural gas industry with statement showing that 24 applications have been filed with FPC during first six months of this year for building 5,784 miles of lines at estimated cost of $217,204,799.

Petroleum Trucking in May 8.1 Per Cent Under Year Ago

NPN News Bureau

WASHINGTON — Transportation of petroleum products in May accounting for about 6% of total tonnage of 1,812,532 reported for all types of motor freight by American Trucking Assn., increased 4.5% over April but dropped 8.1% below May, 1945.

In summing up operations of 85 petroleum carriers during first quarter of this year, ATA reported gross revenues decreased 13.3% from first quarter of 1945; expenses decreased 10.3%; net revenues dropped from $186,727 to deficit of $127,531; intercity miles decreased 13.7%; intercity tons decreased 8.5%.

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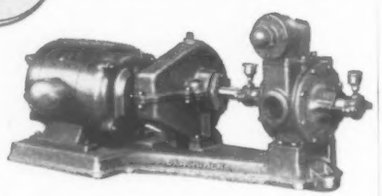

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Oil Markets

MIDWESTERN — Refiners' prices for all products for the most part were unchanged in the Midwest in the week ended June 29. Advances in gasoline quotations were made by some refiners but new prices were within ranges quoted by others.

As the week ended, Group 3 gasoline quotations of refiners ranged from 6.625 to 6.75c for Ethyl, with two refiners at 6.625c and six at 6.75c; 5.875 to 6c for 73-75 oct. regular, with three refiners at the low, one quoting 5.9c, and six at 6c; 5.125 to 5.25c for third-grade (60 oct. & below) with two refiners at 5.125c and seven quoting 5.25c.

Advance of 0.125 to 5.875c in his quotation for regular-grade gasoline was reported by a tank car marketer late in the week. Other marketers asked upward from 5.625c for this grade, and quotations of marketers for other grades were unchanged at 6.375 to 6.625c for Ethyl, 4.75 to 5c for 60 oct. & below.

Gasoline sales reported by marketers during the week totaled 18 cars of Ethyl, one at 6.5c, 17 at 6.625c; and 19 cars of regular-grade, 4 cars at 5.75c, 15 cars at 5.875c.

Marketer also reported selling 9 cars of kerosine with 41-43 bringing 4.75c, and 42-44, 4.875c, and 11 cars of No. 1 p.w. fuel at 4.375c, FOB Group 3. Other marketers offered kerosine at prices ranging from 4.5 to 4.75c for 41-43, 4.5 to 5c for 42-44 and No. 1 p.w. at 4.375c; refiners' quotations were at 4.875c, 5c, and 4.375c, for the three products, respectively.

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CENTRAL MICHIGAN—Heavy shipments of gasoline were reported by Central Michigan refiners throughout the last week of June. Prices for all products generally were unchanged.

Small lots of gasoline were offered in one "highly competitive area" by one refiner at 7c for regular-grade and 8c for Ethyl. In other areas, this refiner said he was getting 7.25c and 8.25c, for the two grades, respectively. Quotations reported by other refiners ranged up to 8.25c for regular, 9.25c for Ethyl. Refiners generally said shipments in June had made deep inroads on inventories.

Kerosine demand fell off during the week but prices were reported unchanged with 44-46 w.w. quoted at 6.25c by one refiner, with other refiners asking 6.3 to 6.5c for 46-49 w.w.

Demand for gas oils and residual fuels continued to tax output, refiners said.

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GULF COAST—Most products were offered sparingly for open market sale by Gulf Coast suppliers in the week ended June 29. Demand continued heavy. With status of OPA and petroleum decontrol undetermined, most suppliers were said by traders to be unwilling to commit themselves for forward delivery at current price levels.

Third-quarter requirements of UNRRA for Poland were understood to have been purchased by Navy the past week for shipment ex Aruba as follows: 96,000 bbls. of kerosine at 4.625c, 76,000 bbls. of Diesel fuel (2-102c) at 4.5c, and three cargoes of motor fuel (72 oct. leaded) at 5.625c.

Army Quartermaster also disclosed the following purchases all for shipment from the U. S. Gulf:

1—60,000 bbls. of kerosine at 4.625c and 70,000 bbls. of 72 oct. leaded gasoline at 5.625c; cargo was lifted June 25; 72 oct. leaded was taken due to no offerings of 65 oct. unleaded which QM had inquired for;

2—Cargo of kerosine at 4.625c, and part-cargo (80,000 bbls.) of 72 oct. leaded gasoline at 5.625c, both for late July lifting;

3—Two cargoes of 72 oct. leaded at 5.75c for late August lifting.

Other sales disclosed the past week included a full cargo of 70 oct. leaded gasoline at 5.625c for prompt lifting; 50,000 bbls. of 74-75 oct. gasoline to jobbers at 5.75c for July barge lifting; 20,000 bbls. of kerosine at 4.625c and equal quantity of No. 2 fuel at 4.25c by one refiner to another refiner, July lifting.

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MIDCONTINENT—Anticipated heavy gasoline consumption over the July 4 holi-

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day, increases in rail freight rates July 1, and harvesting in farm areas combined to sustain exceptionally heavy gasoline shipments from the Midcontinent the last week of June.

Pale neutral oil prices were up 1c per gal. but prices for other products were reported unchanged in most Midcontinent districts.

Many refiners were still short of gasoline and in the market on the buying side. Shipments to the jobbing trade were mainly against contracts. An East Texas refiner reported selling 30,000 gals. each of Ethyl at 7c and regular-grade at 6c for shipment to local jobbers in trucks, but other sales reported the past week were inter-refinery. In West Texas, 15 cars each of 78.5 oct. Ethyl at 7c and 73.5 oct. regular at 6c were sold by one refiner to another. Kansas refiner reported buying 7500 bbls. of regular-grade at 6.125c FOB shipping point on Great Lakes pipeline. East Texas refiner reported buying 27 cars of 60 oct. & below at 5.25c which he said he was blending up to 73-75 oct.

Lube oils continued tight under heavy domestic and export demand, refiners said. Quotation advances of 1c reported by two refiners for pale neutrals effected similar increases in the lows of price ranges with 150 vis. held at 13c, 180 vis. at 13.5 to 15c, 200 vis. at 14 to 15c, 250 vis. at 16 to 16.5c and 280 vis. at 17c.

Heavy fuel also continued tight. Oklahoma refiner reported turning down inquiry from an Illinois steel plant for 1,000,000 gals. of No. 6 oil. Another Oklahoma refiner reported selling 5000 bbls. of No. 6 at $1.05 for late July shipment to a midwest broker.

CRUDE PRICES

Since changes in crude oil prices are infrequent, the two pages of crude oil price tables are printed only when there are sufficient changes to warrant.

A record is kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers.

Crude Price Changes

No price changes for week ending June 26.

For latest table of crude prices published, see NPN June 26, pages 58, 59 and 60.

* * *

ATLANTIC COAST — Continued heavy demand for gasoline was reported by suppliers at most Atlantic Seaboard points the last week of June, and price trend was upward. Other products generally were steady.

Increased gasoline postings were reported by several suppliers at a number of points along the seaboard. As the week ended, regular-grade gasoline was up 0.25c on the low at 7.25c per gal. in the Savannah, Jacksonville, Miami and Tampa districts. Portland, Boston and Providence district prices for regular-grade were up 0.2c on the lows at 8.3c, 7.3c, and 8.2c for the three points, respectively.

Gasoline shipments in all districts were said to be almost entirely against contracts.

* * *

WESTERN PENNA.—Gasoline demand continued active in Western Penna. the past week, and refiners generally reported steady reduction in stocks. Price of 7.75c for 74-76 Oct. was posted late in week by Bradford-Warren Dist. refiner, an advance of 0.25c on the high.

Increased demand for kerosine was reported in lower field at 6.925c for 45 w.w. One refiner who had reported selling at 6.75c last week, returned to 6.925c. Demand was heaviest from industrial users and coal strippers who were using No. 2 fuel blended from kerosine and 36-40 gravity fuel oil.

Permanent increase in all-season call for light fuels was predicted by some refiners who said that number of users returning to coal after recent UMW strike was more than balanced by those who were converting permanently to oil.

Lube prices were reported unchanged, and market remained tight with foreign and domestic demand competing for available supply.

Petrolatums and wax were equally tight, and some refiners said they were still sold up from one to three months.

Summary of Daily Gasoline Prices (June 24 to July 1)

U. S. Motor (ASTM octane)	Monday July 1	Friday June 28	Thursday June 27	Wednesday June 26	Tuesday June 25
78-78.5 octane Ethyl:					
Oklahoma	6.625–6.75	6.625–6.75	6.625–6.75	6.625–6.75	6.625–6.75
Mid-Western (Group 3 basis)	6.75	6.625–6.75	6.625–6.75	6.625–6.75	6.625–6.75
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
E. Tex. (Truck Tnsp.)	7	7	7	7	7
73-75 octane:					
Oklahoma	5.875–6	5.875–6	5.875–6	5.875–6	5.875–6
Mid-Western (Group 3 basis)	6	5.875–6	5.875–6	5.875–6	5.875–6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
E. Tex. (Truck Tnsp.)	6	6	6	6	6
63-66 octane:					
Oklahoma	5.5(1)	5.5(1)	5.5(1)	5.5(1)	5.5(1)
Mid-Western (Group 3 basis)	5.625(1)	5.5(1)	5.5(1)	5.5(1)	5.5(1)
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625(1)	5.625(1)	5.625(1)	5.625(1)	5.625(1)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625(2)	5.625(2)	5.625(2)	5.625(2)	5.625(2)
E. Tex. (Truck Tnsp.)	....	....	....	....	....
60 octane & below:					
Oklahoma	4.875–5.25	5.125–5.25	5.125–5.25	5.125–5.25	5.125–5.25
Mid-Western (Group 3 basis)	5.125–5.25	5.125–5.25	5.125–5.25	5.125–5.25	5.125–5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2–5.25	5.2–5.25	5.2–5.25	5.2–5.25	5.2–5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
E. Tex. (Truck Tnsp.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 78-78.5 oct. (Ethyl (a)					
New York harbor	(2)7.9–9.5(1)	(2)7.9–9.5(1)	(2)7.9–9.5(1)	(2)7.9–9.5(1)	(2)7.9–9.5(1)
New York harbor, barges	(2)7.8–7.9(2)	(2)7.8–7.9(2)	(2)7.8–7.9(2)	(2)7.8–7.9(2)	(2)7.8–7.9(2)
Philadelphia	(2)7.9–9.25(1)	(2)7.9–9.25(1)	(2)7.9–9.25(1)	(2)7.9–8.95(1)	(2)7.9–8.95(1)
Philadelphia, barges	(2)7.8–7.9(1)	(2)7.8–7.9(1)	(2)7.8–7.9(1)	(2)7.8–7.9(1)	(2)7.8–7.9(1)
Baltimore	(2)7.9–9(1)	(2)7.9–9(1)	(2)7.9–9(1)	(2)7.9–8.95(1)	(2)7.9–8.95(1)
Baltimore, barges	(2)7.8–7.9(2)	(2)7.8–7.9(2)	(2)7.8–7.9(2)	(2)7.8–7.9(2)	(2)7.8–7.9(2)
Motor Gasoline, 74-76 oct.					
New York harbor	(2)6.9–8(4)	(2)6.9–8(4)	(2)6.9–8(4)	(2)6.9–8(2)	(2)6.9–8(2)
New York harbor, barges	(2)6.8–7.6(2)	(2)6.8–7.6(2)	(2)6.8–7.6(2)	(2)6.8–7.6(1)	(2)6.8–7.6(1)
Philadelphia	(2)8.9–8(2)	(2)6.9–8(2)	(2)6.9–8(2)	(2)6.9–8(1)	(2)6.9–7.7(5)
Philadelphia, barges	(2)6.8–6.9(1)	(2)6.8–6.9(1)	(2)6.8–6.9(1)	(2)6.8–6.9(1)	(2)6.8–6.9(1)
Baltimore	(2)6.9–7.75(1)	(2)6.9–7.75(1)	(2)6.9–7.75(1)	(2)6.9–7.45(5)	(2)6.9–7.45(5)
Baltimore, barges	(2)6.8–6.9(2)	(2)6.8–6.9(2)	(2)6.8–6.9(2)	(2)6.8–6.9(2)	(2)6.8–6.9(2)
Motor Gasoline:					
Western Penna. Bradford-Warren:					
74-76 Oct.	(1)7.25–7.75(1)	(1)7.25–7.75(1)	(1)7.25–7.75(1)	(1)7.25–7.5(1)	(1)7.25–7.5(1)
Western Penna. Other Districts:					
74-76 Oct.	(3)7–7.25(5)	(3)7–7.25(5)	(3)7–7.25(5)	(3)7–7.25(5)	(3)7–7.25(5)

NOTE: Gasoline prices are as reported in each day's Platt's OILGRAM Daily Oil Price Service. Figures shown in parentheses with Atlantic Coast & Western Penna. prices indicate number of companies at the high and at the low; figures shown in parentheses with other prices in this summary indicate number of companies quoting when less than three are quoting.

(a) Posting of one supplier quoting the lows at New York, Philadelphia & Baltimore are for Min. 80. Oct. (A. S. T. M.) Ethyl.

At Refineries and Terminals and By Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

For complete price service delivered daily from nearest *OILGRAM* publishing office, New York, Cleveland and Tulsa, address Platt's Price Service, Inc., 1213 W. 3rd St., Cleveland (13), Ohio. Annual subscription rate payable in advance $100 per year train mail and $112.50 per year air mail.

Refinery Prices

Gasoline — U. S. Motor (ASTM) octane except where otherwise specified

Prices in Effect	June 24	June 17
OKLAHOMA		
78-78.5 oct. Ethyl	6.625-6.75	6.625-6.75
73-75 oct.	5.875-6	5.875-6
63-66 oct.	5.5(1)	5.5(1)
60 oct. & below	4.875-5.25	5.125-5.25
MID-WESTERN (Group 3 basis)		
78-78.5 oct. Ethyl	6.75	6.625-6.75
73-75 oct.	6	5.875-6
63-66 oct.	5.625(1)	5.5(1)
60 oct. & below	4.875-5.25	5.125-5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78-78.5 oct. Ethyl	7	7
73-75 oct.	6	6
63-66 oct.	5.625(1)	5.625(1)
60 oct. & below	5.2-5.25	5.2-5.25
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78-78.5 oct. Ethyl	7	7
73-75 oct.	6	6
63-66 oct.	5.625(2)	5.625(2)
60 oct. & below	5.25	5.25
E. TEX. (Truck Tnspt.)		
78-78.5 oct.	7	7
73-75 oct.	6	6
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
78-78.5 oct.	7(1)	7(1)
73-75 oct.	6(1)	6(1)
60 oct. & below	5.25(1)	5.25(1)
KANSAS (For Kansas destinations only)		
78-78.5 oct. Ethyl	7.2-7.3	7.2-7.25
73-75 oct.	6.2-6.3	6.2-6.3
63-66 oct.	...	...
60 oct. & below	5.25-5.5	5.25-5.5
ARK. (For shipment to Ark. & La.)		
78-78.5 oct. Ethyl	7(1)	7(1)
73-75 oct.	6(1)	6(1)
60 oct. & below unleaded	5.25(1)	5.25(1)
WESTERN PENNA.		
Bradford-Warren:		
74-76 oct.	(1)7.25-7.25(1)	(1)7.25-7.5(1)
Other districts:		
74-76 oct.	(3)7-7.25(5)	(3)7-7.25(5)
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis; for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor:		
78-78.5 oct.	8-9.25	8-9.25
73-75 oct.	7-8.25	7-8.25
Str. run gasoline, excluding Detroit shpt.	5-6	5-6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances.)		
73-75 oct.	8	8
CALIFORNIA		
80-82 oct. (Ethyl)	8-8.5	8-8.5
74-75 oct.	7-7.5	7-7.5

Kerosine, Gas & Fuel Oils

Prices in Effect	June 24	June 17
OKLAHOMA		
41-43 grav. w.w.	4.875	4.875
42-44 grav. w.w.	5	5
Range Oil	4.5	4.5
No. 1 p.w.	4.375	4.375
No. 1 straw	4.25(1)	4.25(1)
No. 2 straw	4.125	4.125
No. 3 fuel	4	4
No. 6 fuel	$1.11-$1.18	$1.11-$1.18
14-16 fuel	$1.18(1)	$1.18(1)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.875	4.875
42-44 grav. w.w.	5	5
Range Oil	4.5	4.5
No. 1 p.w.	4.375	4.375
No. 2 straw	4.125	4.125
No. 3	4	4
No. 6	$1.11-$1.18	$1.11-$1.18
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4.875	4.875
42-44 grav. w.w.	5(1)	5(1)
No. 1 p.w.	4.375(2)	4.375(2)
58 D.I.	4.55(1)	4.55(1)
No. 6 fuel	$1.18(2)	$1.18(2)
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
No. 2 straw	4.125(1)	4.125(1)
No. 6 fuel	$1.18(1)	$1.18(1)
E. TEX. (Truck trnspt.)		
41-43 grav. w.w.	4.875	4.875
Tractor fuel	4.875-5	4.875-5
Range oil	...	...
No. 1 p.w.	4.25(1)	...
45 Cet. Diesel	4.25(1)	4.25(1)
No. 2 straw	...	...
58 D.I. & above	4.5-4.75(2)	4.5-4.75(2)
No. 6 fuel	$1.18	$1.18
U.G.I. gas oil	3.5(1)	3.5(1)
KANSAS (For Kansas destinations only).		
42-44 grav. w.w.	5.125-5.2	5.125-5.2
No. 1 p.w.	4.6	4.6
No. 6 fuel	$1.23	$1.23
ARK. (For shipment to Ark. and La.)		
42-44 w.w. kero	5(1)	5(1)
No. 2	4.125(1)	4.125(1)
No. 3 fuel	4(1)	4(1)
Tractor fuel	5.5(1)	5.5(1)
Diesel fuel 52 & below	4.5(1)	4.5(1)
Diesel fuel 58 & above	4.75(1)	4.75(1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.	(1)6.5-6.55(2)	(1)6.5-6.55(2)
No. 2 "	6.25(1)	6.25(1)
No. 3 "	6.25(1)	6.25(1)
36-40 gravity	6.25(2)	6.25(2)
Other districts:		
45 grav. w.w.	6.925(8)	(1)6.75-6.925(7)
47 grav. w.w.	7.05(1)	7.05(1)
No. 1 fuel	(4)6.675-6.925(2)	(4)6.675-6.925(2)
No. 2 "	(1)6.25-6.375(7)	(1)6.25-6.375(7)
No. 3 "	(1)6.25-6.375(2)	(1)6.25-6.375(2)
36-40 grav.	(1)5.75-6.375(8)	(1)5.75-6.375(8)

Prices in Effect	July 1	June 24
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
44-46 kerosine	6.25(1)	6.25(1)
46-49 gravity w.w.	6.3-6.5	6.3-6.5
P.W. Distillate	6	6
No. 2 light straw	5.75(1)	5.75(1)
No. 3 gas oil, Straw	5.5	5.5
U.G.I. gas oil	5	5
Fuel Oils (*Vis. at* 100).		
300-500 Vis.	4.64	4.64
100-300 Vis.	5	5
OHIO (S. O. Ohio quotations for statewide delivery)		
Kerosine	7.5	7.5
CALIFORNIA		
40-43 grav. w.w.	....	....
San Joaquin Valley:		
Heavy fuel	$1.25	$1.25
Light fuel	$1.35	$1.35
Diesel fuel	4.75	4.75
Stove dist.	5.75	5.75
Los Angeles:		
Heavy fuel	$1.25	$1.25
Light fuel	$1.35	$1.35
Diesel fuel	4-4.75	4-4.75
Stove dist.	5.75	5.75
San Francisco:		
Heavy Fuel	$1.30	$1.30
Light fuel	$1.40	$1.40
Diesel fuel	5.25	5.25
Stove dist.	6.25	6.25

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	July 1	June 24
WESTERN PENNA		

Prices are for sales made, or offers reliably reported, to jobbers & compounders only.

Viscous Neutrals—*No. 3 col. Vis. at* 70° *F.*

200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	38(1)	38(1)
10 p.t.	37(1)	37(1)
15 p.t.	36(1)	36(1)
25 p.t.	(1)28-33(5)	(1)28-33(5)
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	36(1)	36(1)
10 p.t.	35(1)	35(1)
15 p.t.	34(1)	34(1)
25 p.t.	(1)26-31(5)	(1)26-31(5)

NOTE: Limited quantity neutrals available to regular trade.

Cylinder Stocks:

Brl. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 8 col.*

10 p.t.	30.5(1)	30.5(1)
15 p.t.	29.5(1)	29.5(1)
25 p.t.	25(4)	25(4)
600 S.R. filterable	15(4)	15(4)
650 S.R.	15.5(4)	15.5(4)
600 fl.	16(4)	16(4)
630 fl.	17(4)	17(4)

MID-CONTINENT (F. o. b. Tulsa)

Neutral Oils (*Vis. at* 100° *F. 0 to* 10 *P.P.*)

Pale Oils: Vis. Color		
60-85—No. 2	7.5-8	7.5-8
86-110—No. 2	8-8.5(2)	8-8.5(2)
150—No. 3	13	12-13
180—No. 3	13.5-15	12.5-15
200—No. 3	14-15	13-15
250—No. 3	16-16.5	15-16.5
280—No. 3	17	16-17
300—No. 3	17.5-18(2)	17.5-18(2)
Red Oils:		
180—No. 5	12(1)	12(1)
200—No. 5	12.5(1)	12.5(1)
300—No. 5	16.5-17.5(2)	16.5-17.5(2)
Bright Stock—*Vis. at* 210°		
200 Vis. D	27(1)	27(1)
150-160 Vis. D:		
0 to 10 p.p.	23	23
10 to 25 p.p.	22.5-23	22.5-23
25 to 40 p.p.	23(1)	23(1)
150-160 Vis. E	22(1)	22(1)
120 Vis. D:		
0 to 10 p.p.	22(2)	22(2)
600 S.R. Dark Green	8.5(1)	8.5(1)
600 S.R. Olive Green	10-11(2)	10-11(2)

SOUTH TEXAS (Neutral Oils)

Pale Oils (*Vis. at* 100° *F.*) Vis. Color		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting

Refinery Prices—Continued

Prices in Effect	July 1	June 24
Red Oils:		
100 No. 5-6	6.5(2)	6.5(2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5	10.5

CHICAGO (From Mid-Continent p.l. crude). Neutral oils *vis. at* 100° *F. 0 to* 10 *p.p.*

Pale Oils:		
Vis. Color		
60-85—No. 2	9.5(1)	9.5(1)
86-100—No. 2	9.75(1)	9.75(1)
150—No. 3	13.25(1)	13.25(1)
180—No. 3	14(1)	14(1)
200—No. 3	14(1)	14(1)
250—No. 3	15(1)	15(1)
Red Oils:		
180—No. 5	14(1)	14(1)
200—No. 5	14(1)	14(1)
250—No. 5	15(1)	15(1)
280—No. 5	16(1)	16(1)
300—No. 5	16(1)	16(1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined (*Viscosity at* 210°)		
140	11.5(1)	11.5(1)
160	12.5(1)	12.5(1)
200	13.5(1)	13.5(1)
Bright stocks, 160 *vis. at* 210 *No.* 8 *color:*		
0 to 10 p.p.	24(1)	24(1)
15 to 25 p.p.	23.5(1)	23.5(1)
30 to 40 p.p.	21.5(1)	21.5(1)
E filtered Cyl. Stock	15.5(1)	15.5(1)

Note: To obtain prices delivered in Chicago add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight Basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3		
Grade-26-70	3.25(Sales)	3.25(Sale)
FOB BRECKENRIDGE		
Grade 26-70	2.75(Quote)	2.75(Quote)
CALIFORNIA (FOB plants in Los Angeles basin)		
21-21.9 pound vapor pressure for blending	4.71-4.85(1)	4.71-4.85(1)

Naphthas and Solvents

(*FOB Group* 3)		
Stoddard solvent	6.5-6.625	6.5-6.625
Cleaners' naphtha	7.125	7.125
V.M.&P. naphtha	7.1-7.125	7.1-7.125
Mineral spirits	6.1-6.125	6.1-6.125
Rubber solvent	7.1-7.125	7.1-7.125
Lacquer diluent	7.375-8.125	7.375-8.125
Benzol Diluent	7.875-8.625	7.875-8.625
WESTERN PENNA. *Other Districts:*		
Untreated naphtha(1)	7-7.25(1)	(1)7-7.25(1)
Stoddard solvent	(2)7.25-7.5(1)	(2)7.25-7.5(1)
OHIO (S. O. quotations for statewide delivery): V.M.&P. naphtha. D.C. naphtha, Varnolene & Sohio solvent	9.5	9.5
Rubber solvent	9	9
E. TEXAS (Truck Tnspt.) Stoddard Solvent	7	7

Wax

WESTERN PENNA. (Bbls. C.L.) **White Crude Scale:**		
122-124 A.m.p.	4.25(2)	4.25(2)
124-126 A.m.p.	4.25(3)	4.25(3)
MID-CONTINENT (C.L. FOB Refinery) **Semi-refined:**		
132-134 AMP, bbls.	5.25(1)	5.25(1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose, 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)

Snow White	6.5-7.5	6.5-7.5
Lily White	5.75-6.5	5.75-6.5
Cream White	5-5.875	5-5.875
Light Amber	3.375-4.75	3.375-4.75
Amber	3.5-4.5	3.5-4.5
Red	3.5-4.375	3.5-4.375

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes**; *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect July 1, 1946 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

ATLANTIC REFINING

Atlantic White Flash (*Regular Grade*)

	Commercial T.W.	**Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Philadelphia, Pa	9.0	9.0	5.5	11.25
Pittsburgh	9.5	9.5	5.5	11.6
Allentown	9.3	9.3	5.5	11.6
Erie	9.5	9.5	5.5	11.6
Scranton	9.5	9.5	5.5	11.6
Altoona	9.5	9.5	5.5	11.6
Emporium	9.5	9.5	5.5	11.6
Indiana	9.5	9.5	5.5	11.6
Uniontown	9.5	9.5	5.5	11.6
Harrisburg	9.3	9.3	5.5	11.6
Williamsport	9.5	9.5	5.5	11.6
Dover, Del	...	9.5	5.5	11.6
Wilmington, Del	...	9.0	5.5	11.1
Boston, Mass	...	9.2	4.5	....
Springfield, Mass	...	10.1	4.5	....
Worcester, Mass	...	9.8	4.5	....
Fall River, Mass	...	9.3	4.5	....
Hartford, Conn	...	9.9	4.5	....
New Haven, Conn	...	9.3	4.5	....
Providence, R. I	...	9.3	4.5	....
Atlantic City, N. J	...	8.7	4.5	9
Camden, N. J	...	8.7	4.5	9
Trenton, N. J	...	8.7	4.5	9
Annapolis, Md	...	9.05	5.5	9.8
Baltimore, Md	...	8.45	5.5	8.8
Hagerstown, Md	...	9.55	5.5	9.3
Richmond, Va	...	9.0	7.5	11.3
Wilmington, N. C	...	9.3	7.5	10.9
Brunswick, Ga	...	9.5	7.5	*10.1
Jacksonville, Fla	...	9.5	8.5	11.1

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa	11	12.5
Lancaster, Pa	12	13.5
Pittsburgh, Pa	12.5	13.5

FUEL OILS—T.W.

	1	2	3	5	6
Phila., Pa	9.1	8	8	5.65	4.94
Allentown, Pa	9.6	8.3	8.3	....	....
Wilmington, Del	9.1	8	8	....	....
Springfield, Mass	...	8.4	8.4	....	....
Worcester, Mass	...	8.4	8.4	....	....
Hartford, Conn	...	8.2	8.2	....	....

*Does not include 1c Georgia kerosine tax.

**Prices are to divided and undivided dealers. See page 19 for story.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

CONT'L OIL

	Conoco N-tane (regular) †Tank Wagon	Demand (3rd Grade) Wagon	Gasoline Taxes	Kerosine T.W.
Denver, Col	10	9	5.5	11.5
Grand June., Col	12.5	11.5	5.5	13
Pueblo, Col	9.5	8.5	5.5	10
Casper, Wyo	11.5	10.5	5.5	12.5
Cheyenne, Wyo	10	9	5.5	9.5
Billings, Mont	12	11	6.5	13
Butte, Mont	11.5	10.5	6.5	14
Great Falls, Mont.	12	11	6.5	13
Helena, Mont	12	11	6.5	13.5
Salt Lake City, Utah	13.5	12.5	5.5	15
Twin Falls, Ida	14.5	13.5	7.5	17.5
Albuquerque, N. M.	10.5	9.5	*7	10
Roswell, N. M.	10	9	*7	7.5
Santa Fe, N. M.	10.5	9.5	*7.5	10.5
Ft. Smith, Ark	9	6.25	8	8.5
Texarkana, Ark	8.7	7.2	*5.5	7.5
Muskogee, Okla	7.75	6.75	9	8.5
Oklahoma City, Okla	8	7	9	8.5
Tulsa, Okla	8	7	9	8.5

*Taxes: In gasoline tax columns are included these city taxes—Albuquerque, & Roswell, 0.5c, Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.

†To consumers & dealers.

HUMBLE OIL

	Humble (*Regular*) *Tank Wagon	Re-tail	Thriftane (*3rd Grade*) *Tank Wagon	Re-tail	Gasoline Taxes
Dallas, Tex	*7.5	10.5	*6.5	8.5	5.5
Ft. Worth, Tex	*7.5	10.5	*6.5	8.5	5.5
Houston, Tex	8.5	12.5	7.5	10.5	5.5
San Ant., Tex	8.5	12.5	7.5	10.5	5.5

*Consumer t.w. prices are 1c per gal. higher than dealer t.w. prices shown above.

	Kerosine *Tank Wagon	Retail
Dallas, Tex	7.5	10.5
Ft. Worth, Tex	7.5	11.5
Houston, Tex	8.5	11.5
San Antonio, Tex	7.5	10.5

*To all classes of dealers & consumers.

Canada

PRICES OF IMPERIAL OIL, LTD.
Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

	Esso Gasoline (*Regular Grade*) †Gasoline T.W.	*Gasoline Taxes	Kerosine T.W.
Hamilton, Ont	16.5	11	18
Toronto, Ont	16.5	11	18
Brandon, Man	21.5	10	23.5
Winnipeg, Man	20.0	10	22
Regina, Sask	19.5	11	21.5
Saskatoon, Sask	22.3	11	24.3
Edmonton, Alta	20.4	10	22.4
Calgary, Alta	17.5	10	19.5
Vancouver, B. C.	15	10	24
Montreal, Que	16.5	11	17.5
St. John, N. B.	16	13	19
Halifax, N. S.	16	13	19

*Includes 3c Federal, and Provincial taxes.

†To divided & undivided dealers.

SOCONY VACUUM

	Socony Mobilgas (*Regular Grade*) Com. Cons. T.W.	Undiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	8.9	9.4	*5.5
Kings & Queens	8.9	9.4	*5.5
Richmond	8.5	9.	*5.5
Albany, N. Y.	8.7	9.2	5.5
Binghamton, N. Y.	9.8	10.3	5.5
Buffalo	9.	9.5	5.5
Jamestown, N. Y.	9.2	9.7	5.5
Mt. Vernon, N. Y.	8.9	9.4	5.5
Plattsburg, N. Y.	9.8	10.3	5.5
Rochester, N. Y.	9.6	10.1	5.5
Syracuse, N. Y.	9.3	9.8	5.5
Bridgeport, Conn	8.8	9.3	4.5
Danbury, Conn	9.3	9.8	4.5
Hartford, Conn	9.4	9.9	4.5
New Haven, Conn	8.8	9.3	4.5
Bangor, Me	9.5	10.	5.5
Portland, Me	9.1	9.6	5.5
Boston, Mass	8.7	9.2	4.5
Concord, N. H	10.2	10.7	5.5
Lancaster, N. H	10.8	11.3	5.5
Manchester, N. H	10.1	10.6	5.5
Providence, R. I	8.8	9.3	4.5
Burlington, Vt	9.7	10.2	5.5
Rutland, Vt	9.8	10.3	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	10.5	11.7
New York City	11	12
Rochester, N. Y.	11.5	13
Syracuse, N. Y.	12.2	†16.4
Boston, Mass	12	13
Bridgeport, Conn	†16.3	†17.3
Hartford, Conn	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	T.W.	Mobilfuel Diesel T.C.	T.W.	Mobilheat Fuel Yard	T.W.
New York City:						
Manhat'n & Bronx	6.5	9.3	...	8.3	6.1	8.
Kings & Queens	6.5	9.3	...	8.3	6.1	8.
Richmond	6.5	9.3	...	...	6.1	8.
Albany	6.5	8.8	5.8	8.3	6.	8.
Binghamton	7.9	10.2	...	9.7	7.4	9.2
Buffalo	7.6	9.9	7.	9.3	7.2	9.
Jamestown	7.7	10.	...	9.6	7.3	9.
Mt. Vernon	6.6	9.3	...	8.4	6.2	8.
Plattsburg	7.1	9.4	...	8.9	6.6	8.4
Rochester	7.7	10.	6.9	9.2	6.9	8.7
Syracuse	7.5	9.8	6.3	9.1	6.8	8.6
Conn.:						
Bridgeport	6.8	9.3	...	8.5	6.3	8.
Danbury	7.2	9.8	...	...	6.8	7.5
Hartford	7.	9.5	...	8.5	6.4	8.2
New Haven	6.3	9.3	6.	8.3	5.9	8.
Maine:						
Bangor	6.9	9.3	6.4	8.7	6.4	8.1
Portland	6.5	9.2	5.8	8.3	6.	8.0

Tank Wagon Prices—Continued

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W.	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
Mass.:						
Boston	6 8	9.6	5 8	8.3	6.2	8.1
N. H.:						
Concord	7.4	9.7	...	9.6	7.3	9.1
Lancaster	8 5	10.8	...	10.5	8.2	10.0
Manchester	7.5	10.1	..	9.3	7.0	8.8
R. I.:						
Providence	6 8	9.3	5 8	8.3	6.2	8.1
Vermont:						
Burlington	7.1	9.4	6.5	8.8	6.5	8.2
Rutland	7.3	9.6	..	9.0	6.7	8.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels.

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

S. O. CAL.

	—CHEVRON— (Regular) T.T. Retail	Av. 80 T.T.	Gasoline Taxes	Kerosine T.T.
San Francisco, Cal.	10 14	13.5	4.5	12.25
Los Angeles, Cal.	9.5 13.5	13	4.5	10.75
Fresno, Cal.	11 15	14.5	4.5	13.25
Phoenix, Ariz.	12 16	15.5	6.5	13.25
Reno, Nev.	12 16	15.5	5.5	14.25
Portland, Ore.	10.5 14.5	14	6.5	14.25
Seattle, Wash.	10.5 14.5	14	6.5	14.25
Spokane, Wash.	12.5 16.5	16	6.5	17.25
Tacoma, Wash.	10.5 14.5	14	6.5	14.25
Boise, Idaho	13.5 17.5	17	7.5	17

Resale and Commercial Gasoline—Tank car deliveries of Chevron Aviation 80, unleaded, and Chevron Gasoline .25c per gallon below posted net tank truck price. Pearl Oil (The Standard Kerosine):—Tank car deliveries 3c below posted tank truck price.

S. O. IND.

	Red Crown (Red Grade) Blue Crown (3rd Grade) Red Cr'n. Cons. T.W.	Red Cr'n. Dlr. T.W.	Blue Cr'n. Dlr. T.W.	Gasoline *Taxes	Kerosine T.W.
Chicago, Ill.	11.9	9.9	9.2	4.5	11.1
Decatur, Ill.	11.6	9.6	8.7	4.5	10.8
Joliet, Ill.	11.9	10.3	9.2	4.5	11.1
Peoria, Ill.	11.7	9.9	9.7	4.5	10.9
Indianapolis, Ind.	11.6	10.1	...	5.5	10.6
Evansville, Ind.	11.4	9.9	8.6	5.5	10.4
South Bend, Ind.	12.0	10.5	10.0	5.5	11.0
Detroit, Mich.	11.4	9.9	...	4.5	10.5
Grand Rapids, Mich.	11.4	9.9	...	4.5	10.4
Saginaw, Mich.	11.4	9.9	...	4.5	10.4
Green Bay, Wisc.	12.2	10.7	10.2	5.5	11.4
Milwaukee, Wis.	12.1	10.6	10.1	5.5	11.3
La Crosse, Wis.	11.9	10.4	9.9	5.5	11.1
Minneapolis - St. Paul.	11.9	10.4	9.9	5.5	11.1
Duluth, Minn.	12.2	10.7	...	5.5	11.4
Mankato, Minn.	11.9	10.4	9.9	5.5	11.1
Des Moines, Ia.	11.4	9.9	9.4	5.5	10.6
Mason City, Ia.	11.7	10.2	9.7	5.5	10.9
St. Louis, Mo.	11.0	9.5	9.3	4.5	10.6
Kansas City, Mo.	11.0	9.5	8.6	4.5	10.2
St. Joseph, Mo.	11.0	9.5	...	4.5	10.4
Fargo, N. D.	12.9	11.4	10.9	5.5	12.1
Huron, S. D.	12.3	10.8	10.3	5.5	11.5
Wichita, Kans.	9.8	8.8	7.2	5.5	9.5
Omaha, Neb.	11.4	9.6	9.4	6.5	10.6

Stanavo Ethyl Aviation Number 73

	Cons. T.W.	*Taxes
Detroit, Mich.	16.0	4.5
Fargo, N. D.	15.4	5.5
Huron, S. D.	14.8	5.5
Indianapolis, Ind.	14.5	5.5
Kansas City, Mo.	13.5	4.5

	Oleum Spirits	V.M. & P. Naphtha	Stanisol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'lis	14.2	15.2	13.5	5.5

	Fuel Oils T.W. Chicago Standard Heater Oil	Stanolex Furnace Oil
1-99 gals.	9.8	9.3
100-149 gals.	9.8	8.3
150 gals. & over	8.3	...
150-399 gals.	...	8.3
400 gals. & over	...	7.8

	Stanolex Fuel A	Stanolex Fuel C
1-749 gals.	7.0	6.2
750 gals. & over	6.25	5.45

Stanolex Furnace Oil

Other Points	1-99 gals.	100 gals. & over
Indianapolis	9.5	8.5
Detroit	9.2	8.2
Milwaukee	9.5	8.5
Minneapolis	9.3	8.3
St. Louis	8.9	7.9
Kansas City	8.6	7.6

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 4c state tax. In naphtha tax column are included 1.5c federal tax and state taxes. State sales, occupation, consumer and use taxes to be added where applicable.

S. O. KY.

Crown Gasoline (Regular)

	†Crown Net Dealer	Gasoline Taxes	Kerosine T.W.
Covington, Ky.	9.5	6.5	9.8
Lexington, Ky.	°10.5	6.5	9.8
Louisville, Ky.	°10	6.5	9.3
Paducah, Ky.	°10	6.5	9.3
Jackson, Miss.	°9.75	7.5	*9.25
Vicksburg, Miss.	°9.50	7.5	*9.0
Birmingham, Ala.	°10	*8.5	9.5
Mobile, Ala.	9	*9.5	9.0
Montgomery, Ala.	10	*9.5	*10.5
Atlanta, Ga.	°10.5	7.5	*10.9
Augusta, Ga.	°10.5	7.5	*10.6
Macon, Ga.	°10.5	7.5	*10.9
Savannah, Ga.	9.5	7.5	*10.1
Jacksonville, Fla.	9.5	8.5	9.1
Miami, Fla.	9.5	8.5	9.1
Pensacola, Fla.	9	*9.5	8.5
Tampa, Fla.	9.5	8.5	9.1

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city, Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, included in above prices.

†Consumer t.w. prices are same as net dealer prices.

°Effective June 19.

S. O. N. J.

Esso (Regular Grade)

	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Atlantic City, N. J.	8.70	9.20	4.5	9.0
Newark	8.70	9.20	4.5	9.0
Annapolis, Md.	9.05	9.55	5.5	...
Baltimore	8.45	8.95	5.5	8.8
Cumberland	9.85	10.35	5.5	10.3
Washington, D. C.	8.70	9.20	4.5	9.3
Danville, Va	9.60	10.10	7.5	9.7
Petersburg	9.25	9.75	7.5	9.3
Norfolk	8.70	9.20	7.5	9.0
Richmond	9.0	9.50	7.5	9.3
Roanoke	10.20	10.70	7.5	10.0
Charleston, W. Va.	10.30	10.80	6.5	11.1
Parkersburg	10.30	10.80	6.5	10.8
Wheeling	10.05	10.55	6.5	11.4
Charlotte, N. C.	9.80	10.30	7.5	9.6
Hickory	10.20	10.70	7.5	10.6
Mt. Airy	10.40	10.90	7.5	9.8
Raleigh	10.10	10.60	7.5	10.6
Salisbury	9.90	10.40	7.5	11.0
Charleston, S. C.	9.20	9.70	7.5	...
Columbia	10.10	10.60	7.5	...
Spartanburg	9.60	10.10	7.5	...
New Orleans, La.	8.45	8.95	8.5	*7.5
Baton Rouge	8.45	8.95	8.5	*8.0
Alexandria	8.45	8.95	8.5	*8.0
Lake Charles	8.70	9.20	8.5	*9.5
Shreveport	8.20	8.70	8.5	*6.5
New Iveria, La.	8.70	9.20	8.5	*7.5
Knoxville, Tenn.	9.95	10.45	8.5	11.0
Memphis	8.90	9.40	8.5	9.0
Chattanooga	9.70	10.20	8.5	9.5
Nashville	10.20	10.70	8.5	8.5
Bristol	°9.50	°10.00	8.5	10.5
Little Rock, Ark.	9.20	9.70	8.0	10.5

°Effective June 20; correct prices have been 8.75c for Consumer T.W. & 9.25c for Dealer T.W. on and since Feb. 13, 1946, according to company correction.

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	13.5	....
Washington, D. C.	13.5	....

Fuel Oils—T.W.	No. 1	No. 2
Atlantic City, N. J.	9.0	8.0
Newark	9.0	8.0
Baltimore, Md.	8.8	8.0
Washington, D. C.	9.3	8.1
Norfolk, Va.	9.0	7.8
Petersburg	9.3	8.0
Richmond	9.3	8.0
Charlotte, N. C.	9.6	9.4
Hickory	...	9.0
Raleigh	10.6	9.1
Charleston, S. C.	...	8.0
Columbia	...	9.0
Spartanburg	..	9.8

*Does not include 1c Louisiana kerosine tax.

Discounts:

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—In South Carolina 1c per gal. off posted t.w. price for 25 gals. or more. In Arkansas 2c per gal. off posted t.w. price.

Naphtha—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

S. O. OHIO

Sohio X-70 Gasoline (Regular Grade)

	Consumer T.W.	Reselers	°S.S.	Gasoline Taxes	Kerosine T.W.
Ohio, Statewide	††12	10	13.5	5.5	9.8
Akron	12	9.5	12.5	5.5	9.8
Canton	12	9.5	12.5	5.5	9.8
Cincinnati	12	9.5	12.5	5.5	9.8
Cleveland	12	9.5	12.5	5.5	9.8
Columbus	12	9.5	12.5	5.5	9.8
Dayton	12	9.5	12.5	5.5	9.8
Lima	12	9.5	12.5	5.5	9.8
Mansfield	12	9.5	12.5	5.5	9.8
Marion	12	9.5	12.0	5.5	9.8
Portsmouth	12	9.5	12.5	5.5	9.8
Toledo	12	9.5	12.5	5.5	9.8
Youngstown	12	9.5	12.5	5.5	9.8
Zanesville	12	9.5	12.5	5.5	9.8

°°Aviation Gasoline—Statewide

	Consumer Gasoline T.W.	Taxes
Sohio Aviation Gasoline Clear Spec. AN-F-22, Amend. 1	14.5	5.5
Esso (Clear) Avia. Grade 80	16.5	5.5
Esso Aviation Grade 91/98	17.5	5.5
Esso Aviation Grade 100/130	20.5	5.5

Naphtha—T.W.

	Statewide
S. R. Solvent	13.5
D. C. Naphtha	14
V.M.&P. Naphtha	14
Varnolene	14
Sohio Solvent	14

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.8	8.8	8.3	*8.05

**Renown (third-grade) prices are same as X-70 unless otherwise noted.

°Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only. Full compartment hose dumps.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

°°Manufacture of Esso Ethyl Aviation Gasoline Grade 73, discontinued June 30.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (Regular)	Indian (3rd Grade)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

Notice

Tank Wagon prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 2/25c; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Neb. 2/100c; Nev. 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/40c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Ala. 1/2c; Fla. 1/8c; Iowa 3/50c; Mich. 1/5c per gal.

Atlantic Coast

Seaboard Export Coastwise Prices

(Prices are of refiners, FOB their refineries and tanker terminals, and of tanker terminal operators FOB their terminals)—Prices in Effect July 1

	MOTOR GASOLINE (ASTM Octane)		KEROSINE & FUEL OILS				
District	74-76 Oct.	78-78.5 Oct. (Ethyl) (b)	NO. 1 FUEL	KEROSINE &/OR NO. 2 FUEL	NO. 3 FUEL	No. 5	No. 6
N. Y. Harb.	(2)6.9–8(4)	(2)7.9–9.5(1)	6.1(15)	5.7(13)	5.7(1)	$1.90(4a)	$1.72(10)
N. Y. Harb., barges	(2)6.8–7.6(2)	(2)7.8–7.9(2)	6(12)	5.6(13)	5.6(1)	....	....
Albany	(6)8.1–8.15(1)	(1)9.15–9.6(2)	6.3(8)	5.8(6)	5.8(1)	....	$1.92(1)
Philadelphia	(2)6.9–8(3)	(2)7.9–9.25(2)	6.2(12)	5.7(12)	5.7(3)	$1.93(3)	$1.72(8)
Philadelphia, barges	(2)6.8–6.9(1)	(2)7.8–7.9(1)	....	....	....	....	....
Baltimore	(2)6.9–7.75(1)	(2)7.9–9(1)	6.2(9)	5.7(8)	5.7(1)	$1.80(1)	$1.72(4)
Baltimore, barges	(2)6.8–6.9(2)	(2)7.8–7.9(2)	....	....	....	....	....
Norfolk	(1)6.75–7.25(1)	(1)7.75–8.5(1)	6.1(7)	5.7(6)	....	$1.76(1)	$1.68(3)
Wilmington, N.C.	(3)6.65–7.35(1)	(1)7.65–9.05(1)	6.05(9)	5.7(6)	....	....	....
Charleston	(1)6.65–7.25(2)	(1)7.65–8.5(1)	6.2(5)	5.7(3)	....	$1.71(1)	$1.63(2)
Savannah	(6)7.25–7.375(1)	8.25(3)	6.05(6)	5.25(3)	5.25(1)	....	$1.63(1)
Jacksonville	(6)7.25–7.37(1)	8.25(4)	6.05(7)	5.25(5)	....	....	(2)$1.58–1.63(3)
Miami	(6)7.25–7.37(1)	8–8.25(3)	6.05(5)	5.25(1)	....	....	....
Tampa	(7)7–7.37(1)	8–8.25(4)	6.05(8)	5.25(5)	....	....	(2)$1.49–$1.53(2
Pensacola	7(1)	....	5.3(1)	5.25(1)	....	....	....
Mobile	(1)6.75–6.87(1)	....	5.25(2)	....	....	....	....
New Orleans	(2)6–6.25(1)	(2)6.75–7.25(1)	4.625(3)	4.25(2)	....	$1.26(1)	$1.18(4)
Portland	8.3057	(1)9.55–9.8(1)	6.3(2)	5.8(6)	5.8(1)	$2.245(1)	$1.765(3)
Boston	(1)7.3–8.2(5)	(1)8.3–9.7(1)	6.2(9)	5.8(8)	5.8(1)	$1.945(3)	$1.765(4)
Providence	8.2(6)	(1)9.45–9.7(1)	6.2(9)	5.8(7)	5.8(1)	$1.865(2)	$1.735(4)
New Haven	....	....	....	....	....	....	$1.735(1)

(a) Price is for straight-run low pour test No. 5; three refiners quote $1.80 for high pour test No. 5.

(b) Postings of one supplier quoting the lows at New York, Philadelphia & Baltimore are for Min. 80 Oct. (A. S. T. M.) Ethyl.

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ship's bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
N. Y. Harbor	$1.72(8)	$2.36(6)	5.7(1)	5.8(2)
Albany	$1.92(1)	$2.52(1)	5.8(1)	6(1)
Philadelphia	$1.72(7)	$2.36(4)	....	....
Baltimore	$1.72(3)	$2.36(2)	5.7(1)	....
Norfolk	$1.68(3)	$2.36(2)	5.7(1)	....
Charleston	$1.63(2)	$2.36(2)	5.7(1)	....
Savannah	$1.63(1)	....	....	....
Jacksonville	(2)$1.58–$1.63(3)	$2.20(1)	....	....
Tampa	(2)$1.49–$1.53(2)	....	....	....
New Orleans	$1.18(4)	$1.86(1)	....	....
Portland	$1.765(3)	....	5.8(1)	5.9(1)
Boston	$1.765(3)	$2.40(1)	5.8(2)	5.9(1)
Providence	$1.735(4)	$2.402(2)	5.8(1)	5.9(1)
New Haven	....	....	....	....

Gulf Coast

Prices in Effect July 1

	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	Barges	Texas Gulf Coast South of New Orleans Tank Cars	Barges	CARGOES Domestic & Export From all Gulf Ports
MOTOR GASOLINE					
78-78.5 Oct. Ethyl	6.75(2)	6.5(2)	....	(1)6.25–6.75(2)	(3)6.25–6.75(1)
74-76 Oct.	6(3)	5.75(2)	5.75–6(a)	5.75(6)	5.75(10)
70-72 Oct.	....	....	....	....	(4)5.625–5.75(1)
Unleaded (ASTM Oct.)					
70 Oct.	....	....	....	....	5.625(2)
68 Oct.	....	....	....	....	5.5(2)
65 Oct.	....	5.5(1)	....	....	(3)5.25–5.5(1)
60 Oct.	....	....	....	....	5(1)
KEROSINE & LIGHT FUELS					
41-43 w.w. kero	4.625(3)	4.625(3)	4.625(2)	4.625(4)	4.625(3)
42-44 w.w. kero	....	....	4.625(1)	4.625(1)	4.625(1)
No. 2 fuel oil	4.25(4)	4.25(4)	4.25(2)	4.25(4)	4.25(5)
DIESEL & GAS OILS (In diesel index No.)					
No. 5 fuel oil	$1.26(1)	$1.26(1)	$1.26(1)	$1.26(1)	$1.26(1)
43-47 di.	....	....	....	....	4.5(2)
48-52 di.	4.5(2)	4.5(2)	4.5(2)	4.5(2)	4.5(1)
53-57 di.	4.625(2)	4.625(2)	4.625(3)	4.625(2)	4.625(2)
58 and above	4.75(2)	4.75(2)	4.75(2)	4.75(2)	4.75(1)

(a) One refiner quotes 5.75c for shipment to Dist. 1, 6c for shipment to other districts; one other refiner quotes 5.75c for unrestricted shipment.

HEAVY FUELS & BUNKER OIL (all Gulf Ports) Heavy Diesels	In Cargoes	In Ship's Bunkers (Ex Lighterage)
Below 28 API Grav.	....	(1)$1.35–$1.56(2)
28 & above API Grav.	....	$1.86(6)
Bunker C Oil	$1.18(6)	$1.18 11)

TANKER RATES

Approximate rates, cents per bbl.: Gulf-N. Atlantic, not east of New York

Heavy crude & fuel, 10-19.9 grav.	43.8
Light crude, 30 grav. or lighter	39
Gasoline	32.9
Kerosine	36
No. 2 fuel	38

Mid-Continent Lubes

(At Gulf; in packages, FAS. New Orleans; in bulk, FOB terminals).

Prices in Effect July 1

Bright Stock *D color, Vis at 210°*	Steel Drums	Bulk
150 vis., 0-10 p.p.	32.65 (1)	24.8 (1)

Pacific Coast

(In Ships' Bunkers, or Deep Tank Lots)

	Prices in Effect July 1 Diesel Fuel (P.S. 200)	Bunker C Fuel (P.S. 400)
San Pedro, Calif.	$1.765	$1.25
San Francisco, Calif.	1.815	1.30
Portland, Ore.	2.015	1.45
Seattle, Wash.	2.015	1.45

NOTE: In Atlantic & Gulf Coast price tables, figures in parentheses indicate number of companies at the high and at the low. In other tables on this page, figures in parentheses indicate number of companies quoting when less than three are quoting.

Wax

(Melting points are AMP, 3° higher than EMP. Prices are FOB refinery and do not include bag, freight or export differentials).

Prices in Effect July 1

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25 (1)	....	4.25(1)
122-4 White	....	4.25 (2)	4.25(2)
124-6 White	4.25 (1)	4.25	4.25
Fully Refined:			
123-5	5.2 (1)	5.2 (2)	5.2 (1)
125-7	5.2 (1)	5.2 (2)	5.2 (2)
128-30	5.6 (1)	5.6	5.6 (1)
130-32	5.85 (1)	5.85 (2)	5.85 (1)
133-5	6.15 (1)	6.15	6.15 (2)
135-7	6.4 (1)	6.4 (1)	6.4 (1)

Naphtha

Effective July 1

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

Export Prices

Prices in Effect July 1

	Mexican Gulf Ports U. S. Dollars per Bbl Bunker C (Ships' Bunkers)	Diesel (Ships' Bunkers)
Tampico	$1.18	$1.86
Veracruz	1.18	....
Coatzacoalcos	1.18	1.86
Pacific Coast		
Guaymas	$1.65	$3.22
Mazatlan	1.65*	3.22
Acapulco	1.65	2.89
Manzanillo	1.65	2.89
Salina Cruz	1.65	2.89

Note: All bunkers sales subject to Mexican stamp tax of 1.65% ad valorem.

*Port accessible only for small vessels drawing 14 to 15 feet.

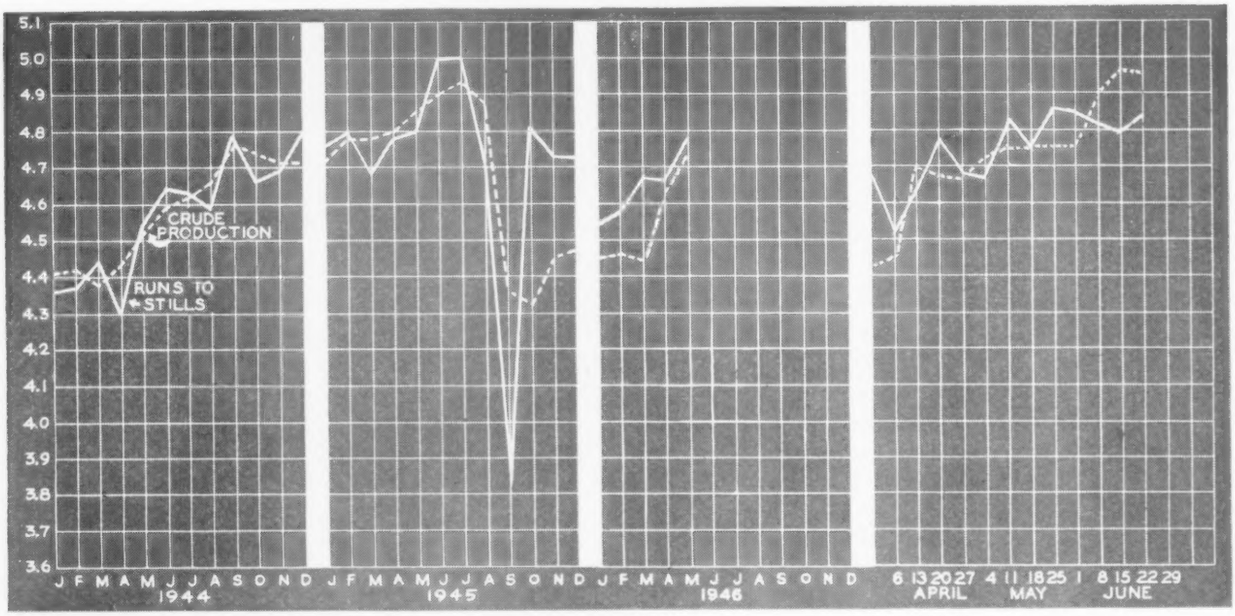
NPN Gasoline Index

	Dealer T.W.	Tank Car
	Cents Per Gal.	
July 1	9.87	6.43
Month ago	9.80	6.31
Year ago	10.27	6.72

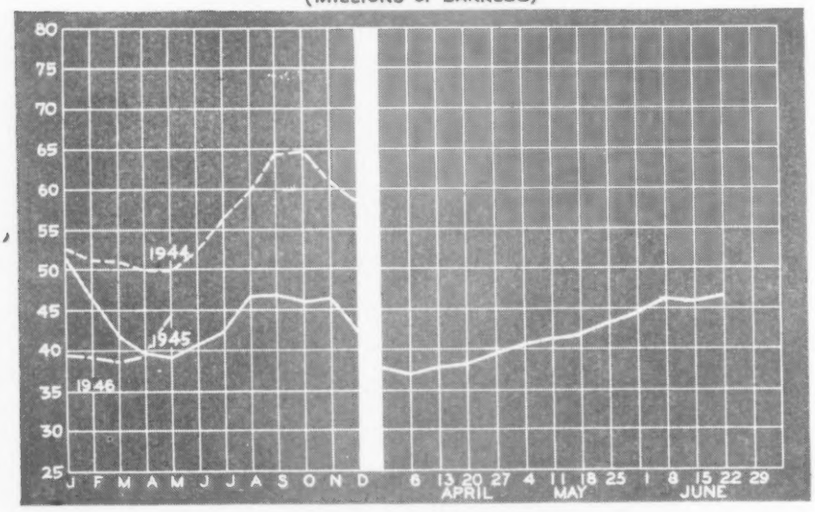
Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

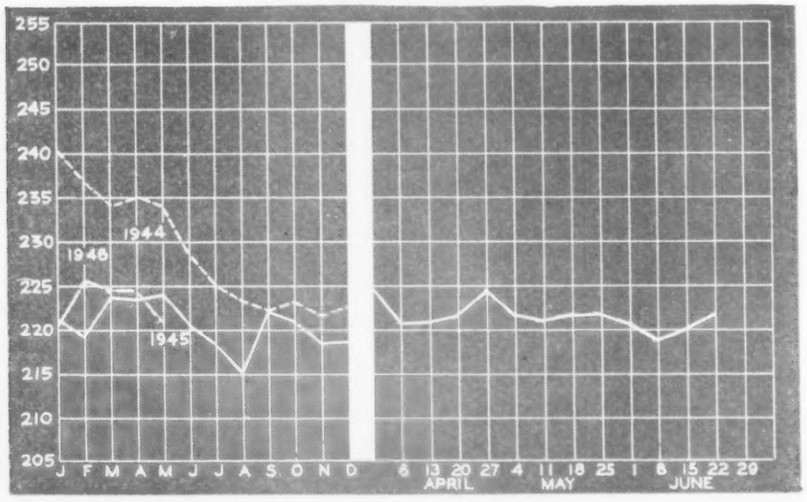
CRUDE PRODUCTION AND RUNS TO STILLS
(MILLIONS OF BARRELS)



RESIDUAL FUEL OIL STOCKS
(MILLIONS OF BARRELS)



CRUDE OIL STOCKS
(MILLIONS OF BARRELS)



Daily Ave. Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week Ended June 22, 1946	Week Ended June 15, 1946	Week Ended June 23, 1945
63,480	56,306	67,205

Crude Oil Stocks

(Thousands of bbls.)
(Bureau of Mines figures)

	June 15	June 22	Change from June 15
Penna. Grade	2,433	2,421	— 12
Other Appalachian	1,704	1,641	— 63
Lima-Michigan	1,106	1,103	— 3
Illinois-Indiana	16,880	17,665	+785
Arkansas	2,491	2,657	+166
Kansas	8,623	8,426	—197
Louisiana	10,295	10,768	+473
North	2,605	2,960	+355
Gulf Coast	7,690	7,808	+118
Mississippi	2,366	2,509	+143
New Mexico	5,679	5,867	+208
Oklahoma	33,709	33,916	+207
Texas	102,929	103,411	+482
East Texas	16,834	16,806	— 28
West Texas	34,636	35,141	+505
Gulf Texas	27,204	27,651	+447
Other Texas	24,255	23,813	—442
Panhandle	4,210	4,444	+234
North	6,404	6,415	+ 11
South	5,390	5,082	—308
Other	8,251	7,872	—379
Rocky Mountain	8,277	8,342	+ 65
California	19,905	20,068	+163
Foreign	3,709	3,379	—330
Total gasoline-bearing in U. S.	220,106	222,193	+2,087
Heavy in California	4,783	4,916	+129
Total located in Bureau of Mines East Coast district	13,950	13,700	—250

REFINERY OPERATIONS

(*American Petroleum Institute figures in thousands of barrels of 42 gallons each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.*)

Districts	Daily Average Crude Runs to Stills Week Ended		Gasoline Production at Refineries Inc. Natural Blended Week Ended		Kerosine Production Week Ended		Gas Oil & Dist. Fuel Oil Production Week Ended		Residual Fuel Oil Production Week Ended	
	June 22	June 15	June 22	June 15	June 22	June 15	June 22	June 15	June 22	June 15
East Coast	816	761	1,712	1,726	277	329	1,055	941	1,602	1,521
Appalachian (Dist. 1)	104	96	292	310	54	28	64	81	91	88
Appalachian (Dist. 2)	54	54	184	184	6	14	39	40	75	97
Ind., Ill., Ky.	749	748	2,724	2,733	270	294	664	714	1,053	1,081
Okla., Kans., Mo.	381	389	1,276	1,336	178	183	424	478	486	456
Inland Texas	212	212	975	893	76	74	91	113	418	406
Texas Gulf Coast	1,188	1,206	3,373	3,694	620	625	1,789	1,796	1,851	1,877
Louisiana Gulf Coast	335	334	900	1,009	340	272	511	525	423	367
No. La. & Arkansas	52	57	123	149	36	37	68	72	79	94
Rocky Mt. (Dist. 3)	12	11	41	42	6	6	10	10	28	26
Rocky Mt. (Dist. 4)	129	129	369	354	21	17	108	117	247	261
California	804	802	2,302	2,080	44	189	769	560	2,353	2,657
Total U. S.—B. of M. Basis	4,836	4,799	14,271	14,510	1,928	2,068	5,592	5,447	8,706	8,931
U. S.—B. of M. Basis, June 23, 1945	5,067		15,200		1,410		5,106		9,903	

Districts	Total Stocks Kerosine Week Ended		Total Stocks Gas Oil and Distillates Week Ended		Total Stocks Residual Fuel Oil Week Ended		Stocks of Finished and Unfinished Gasoline Week Ended		Per Cent Daily Refining Capacity Reported Week Ended	
	June 22	June 15	June 22	June 15	June 22	June 15	June 22	June 15	June 22	June 15
East Coast	5,340	5,432	11,272	10,955	8,517	8,306	22,890	22,894	99.5	99.5
Appalachian (Dist. 1)	285	266	429	453	218	203	2,495	2,466	76.3	76.3
Appalachian (Dist. 2)	62	67	138	147	170	191	1,052	1,025	84.7	84.7
Ind., Ill., Ky.	2,130	1,992	5,029	4,921	3,663	3,635	18,608	19 058	87.4	87.4
Okla., Kans., Mo.	877	827	2,218	2,117	1,270	1,271	8,233	8,137	78.3	78.3
Inland Texas	366	364	361	350	673	689	2.942	3,024	59.8	59.8
Texas Gulf Coast	2,317	2,332	6,190	5,821	5,678	5,315	14.214	14,140	89.2	89.2
Louisiana Gulf Coast	1,298	1,270	1,641	1,791	1,335	1,335	3,712	3,997	97.4	97.4
N. La. & Arkansas	195	204	454	406	174	191	1,832	1,841	55.9	55.9
Rocky Mt. (Dist. 3)	20	20	43	42	39	34	92	91	19 0	19.0
Rocky Mt. (Dist. 4)	144	136	451	443	708	747	2,059	2,140	70.9	70.9
California	710	701	8.194	8.136	24.081	23 998	14,765	14,636	85.5	85.5
Total U. S.—B. of M. Basis	13,744	13,611	36,420	35,582	46,526	45,915	*92,894	93,449	85.8	85.8
U. S.—B. of M. Basis June 23, 1945	9,058		31,694		40,165		†87,099			

Unfinished gasoline stocks included are: *8,689,000 bbls.; †12,124,000 bbls.

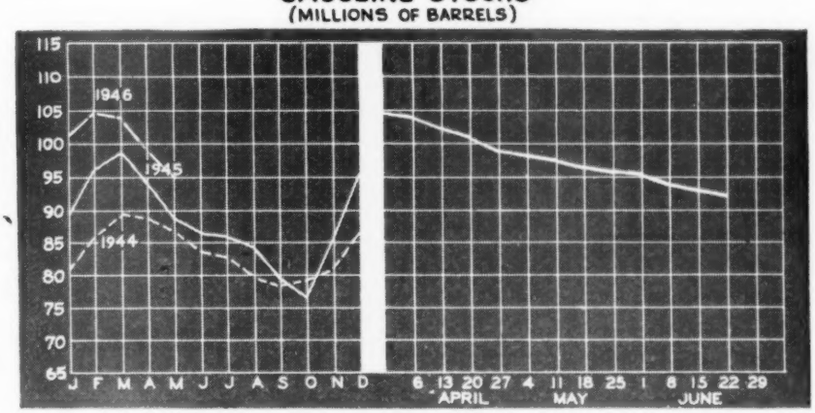
U. S. Crude Oil Production

(*American Petroleum Institute figures*)

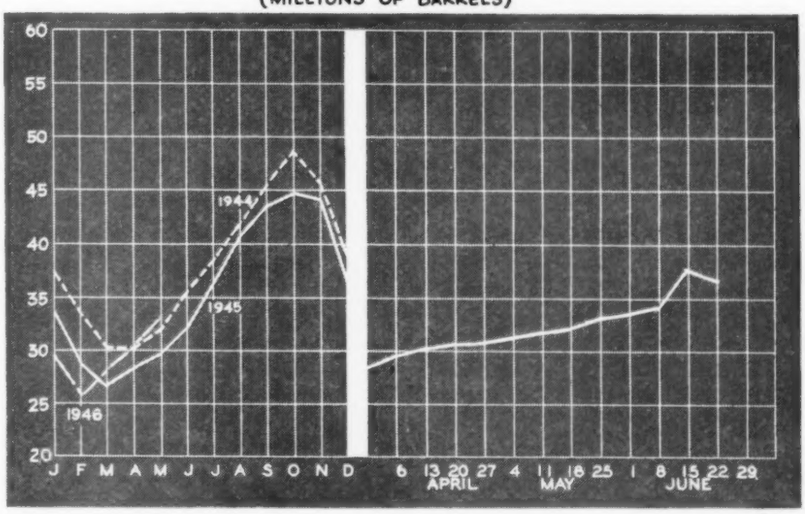
	Week Ended June 22 Barrels (Daily Average)	Week Ended June 15 Barrels (Daily Average)
*New York-Penna.	50,800	50,350
Florida	250	250
*West Virginia	9,050	8,800
*Ohio—Southeast	5,250	5,650
*Ohio—Other	2,100	2,850
Indiana	19,900	19,600
Illinois	208,150	207,800
Kentucky	31,200	29,900
Michigan	45.100	50,150
Nebraska	†750	750
Kansas	†277,450	282.900
Oklahoma	†388,500	383,150
Texas:		
District 1	19,650	19,650
District 2	155,650	155,650
District 3	515,400	515,400
District 4	229,600	229,600
District 5	43,950	43,950
East Texas	326.000	326 000
Other District 6	107.350	107.350
District 7-B	32,400	32.400
District 7-C	28,450	28,450
District 8	566,450	580,450
District 9	132,400	132,400
District 10	86,450	86,450
Total Texas	2,243,750	2,257,750
North Louisiana	81,900	81,750
South Louisiana	296,100	296,100
Total Louisiana	378,000	377,850
Arkansas	73,650	74,150
Mississippi	63,150	63,450
Alabama	1,150	1,150
New Mexico—Southeast	97,600	97,600
New Mexico—Other	500	500
Wyoming	111,600	117,350
Montana	25,750	21,800
Colorado	32,850	31,800
California	883,000	875,100
Total U. S.	4,949,500	4,960,650
°Penna Grade crude included	65,100	64,800

*Okla., Kansas, Neb. figures are for week ended 7 a.m. June 19, 1946.

GASOLINE STOCKS
(MILLIONS OF BARRELS)



GAS OIL AND DISTILLATE STOCKS
(MILLIONS OF BARRELS)



Pacific Coast Demand

(Bureau of Mines figures in thousands of b/d)

	Gasoline		Gas Oil & Diesel		Heavy Fuel Oil		All Products	
	1945	1946	1945	1946	1945	1946	1945	1946
January	304	248	104	139	545	432	1,066	917
February	315	283	100	129	594	439	1,124	947
March	332	300	94	106	519	448	1,068	962
April	406	274	83	106	536	376	1,148	851
May	402	...	75	...	520	...	1,133	...
June	398	...	64	...	490	...	1,085	...
July	396	...	59	...	421	...	1,011	...
August	370	...	78	...	434	...	1,010	...
September	363	...	76	...	400	...	954	...
October	269	...	76	...	443	...	897	...
November	271	...	106	...	418	...	901	...
December	265	...	117	...	479	...	969	...
Jan.-Apr.	339	276	95	118	548	423	1,101	920

Midcontinent Lubricating Oils

(All figures are in bbls. of 42 gals.)

	Bright Stocks	Viscous Neutrals	Paraffin Oils	Steam Refined Stock	Blended Oils
Production	233,703	354,271	70,353	21,308	396,880
Shipments:					
Domestic	309,351	354,102	63,298	28,747	368,473
Export	17,219	6,319	116	232	30,635
TOTAL	326,570	360,421	63,414	28,979	399,108
Inventory, April 30, 1946	248,075	209,152	74,447	25,338	183,867
Days Supply	33	20	.....	.....	.....

Pennsylvania Lubricating Oils

(Compiled by National Petroleum Assn. from reports of companies refining Pennsylvania Grade crude oil. Figures in bbls.)

	Production April 1946	Inventory April 1946	Production March 1946	Inventory March 1946
Raw long residuum	12,486	8,110	17,801	5,484
600 steam refined stock	233,129	115,889	266,035	120,611
Other steam refined stock	55,852	40,609	43,305	43,337
Finished dewaxed long residuum	35,934	41,830	47,135	38,661
Bright stock	156,506	183,051	172,837	200,768
Viscous neutral (below 180 Vis.)	70,006	127,072	59,887	126,670
Viscous neutral (180 Vis. at 100)	87,973	85,974	102,759	96,713

Production of Natural Gasoline

(Bureau of Mines figures in gallons, 000 omitted)

	Apr. 1945	Mar. 1945
East Coast	.....	.....
W. New York	.....	.....
W. Pennsylvania	1 360	1,497
West Virginia	7,260	7,864
Ohio	534	610
Illinois	15,157	15,428
Kentucky	4 426	4,438
Michigan	1,097	1,126
Kansas	5 592	5,691
Oklahoma	33 723	35 120
Texas:	179 086	181 994
Gulf	43 024	45 019
East Texas	30 100	31,254
Panhandle	46 627	45,799
Other	59 335	59,922
Arkansas	7 138	7 567
Louisiana:	45,172	49,719
Gulf	24 462	28 416
Inland	20 710	21 375
New Mexico	8 476	8,531
Colorado	(*)	(*)
Montana	478	508
Wyoming	*4 355	*4,816
California	74,978	74,980
Total	388 832	399,964
Daily average	12,961	12 902
Total (thousands of bbls.)	9,258	9,523
Daily average	309	307

*Wyoming includes Colorado drip gasoline.

Dealer & Service Station Prices for Regular-Grade Gasoline in 50 Representative U.S. Cities June 1, 1946

(American Petroleum Institute Figures)

City & State	Dealers' Net Price (Ex. Tax)	Indicated Dealer Margin	Gasoline Tax (Inc. 1½ Cent Federal Tax)	Service Station (Inc. Tax)
Average United States	9.90	4.25	6.07	20.22
Portland, Me.	9.60	4.00	5.50	19.10
Manchester, N. H.	10.60	4.10	5.50	20.20
Burlington, Vt.	10.20	4.00	5.50	19.70
Boston, Mass.	9.20	4.00	4.50	17.70
Providence, R. I.	9.30	4.50	4.50	18.30
Hartford, Conn.	9.80	4.10	4.50	18.40
Buffalo, N. Y.	9.50	4.50	5.50	19.50
New York, N. Y.	9.40	5.40	5.50	20.30
Newark, N. J.	8.70	5.00	4.50	18.20
Philadelphia, Pa.	8.70	4.30	5.50	18.50
Dover, Del.	9.20	4.30	5.50	19.00
Baltimore, Md.	8.45	4.35	5.50	18.30
Washington, D. C.	8.70	4.30	4.50	17.50
Charleston, W. Va.	10.30	5.00	6.50	21.80
Norfolk, Va.	8.70	6.10	6.50	21.30
Charlotte, N. C.	9.80	4.50	7.50	21.80
Charleston, S. C.	9.20	5.00	7.50	21.70
Atlanta, Ga.	10.25	4.75	7.50	22.00
Jacksonville, Fla.	9.50	4.00	8.50	22.00
Birmingham, Ala.	9.75	4.75	8.50	*23.00
Vicksburg, Miss.	9.25	5.25	7.50	22.00
Memphis, Tenn.	8.90	4.50	8.50	21.90
Youngstown, Ohio	9.50	3.00	5.50	18.00
Lexington, Ky.	10.25	3.75	6.50	20.50
South Bend, Ind.	10.20	4.80	5.50	20.50
Chicago, Ill.	9.60	2.76	4.50	16.86
Detroit, Mich.	9.60	3.92	4.50	18.02
Milwaukee, Wisc.	10.30	4.60	5.50	20.40
Twin Cities, Minn.	10.10	4.80	5.50	20.40
Fargo, N. Dak.	11.10	4.60	5.50	20.60
Huron, S. Dak.	10.50	4.00	5.50	20.00
Omaha, Neb.	9.60	3.00	6.50	19.10
Des Moines, Ia.	9.60	3.60	5.50	18.70
St. Louis, Mo.	9.50	3.00	4.50	*17.00
Wichita, Kans.	8.60	3.40	5.50	17.50
Tulsa, Okla.	8.00	3.00	9.00	20.00
Little Rock, Ark.	9.20	4.80	8.00	22.00
New Orleans, La.	8.45	5.05	8.50	22.00
Houston, Texas	8.50	4.50	5.50	18.50
Albuquerque, N. Mex.	10.50	4.50	7.00	**22.00
Denver, Colo.	10.00	4.00	5.50	19.50
Casper, Wyo.	11.50	5.00	5.50	22.00
Butte, Mont.	9.50	4.00	6.50	20.00
Boise, Ida.	13.50	4.00	7.50	25.00
Salt Lake City, Utah	13.50	4.50	5.50	23.50
Reno, Nev.	12.00	4.00	5.50	21.50
Phoenix, Ariz.	12.00	4.00	6.50	22.50
San Francisco, Calif.	10.00	4.00	4.50	18.50
Portland, Ore.	10.50	4.00	6.50	21.00
Spokane, Wash.	12.50	4.00	6.50	23.00

* Includes City Tax of 1.00.
** Includes City Tax of 0.50.

Pennsylvania Oils Other Than Lubes at Refineries

(Compiled by National Petroleum Assn. from reports of oil region refiners. Figures in barrels.)

	Apr. 1946	Mar. 1946
Naphthas & Gasoline		
(1) Straight run, unblended and/or unleaded for sale as motor fuel	4,208	4,234
(2) Naphtha and gasoline, for sale for blending or further refining, or held at refinery for further distillation, reforming, blending or leading	336,187	309,706
(3) Below 65 octane, not included in (1) or (2) above	2 797	5,956
(4) 65 octane and above	301,425	408,468
Salable Naphthas other than motor fuel (does not include refinery process naphthas)	13,198	21,568
Kerosine	97 678	86 862
36/40 gas oil (include furnace oil)	45,843	54,208
Fuel oil (not reported above)	20,229	32,491
Oils held as c acking plant charging stocks	308 629	246 639
Non-viscous neutral	24 797	23,420
Wax distillate	77,561	74,175
Crude Petrolatum	33 908	36,424
Wax (lbs.)	3,901,093	4,147,147

Net Stocks of Pennsylvania Crude Oil

(Compiled by National Petroleum Assn. Figures in bbls.)

	Apr. 30, 1946	Mar. 31, 1946	Apr 30, 1945
At Refineries	263,009	236 300	296,230
Pipeline and Tank Farm	1,631,839	1,482,421	1,370,312
Total	1,894,848	1,718,721	1,666,542

THIS EMBLEM

is a TWO-WAY assurance of quality

Only motor oils of the highest quality are entitled to use the emblem of the Pennsylvania Grade Crude Oil Association. Millions of motorists know this and have made the emblem their buying guide through the years.

In addition to assuring money's worth to the customer, this emblem also tells the customer that those who sell 100% Pure Pennsylvania Motor Oils — jobbers and dealers alike — are selling quality, performance, complete satisfaction.

PENNSYLVANIA GRADE
CRUDE OIL ASSOCIATION
Oil City, Pennsylvania

For your protection, only oils made from 100% Pure Pennsylvania Grade Crude which meet our rigid quality requirements are entitled to carry this emblem, the registered badge of source, quality and membership in our Association.

'Selling' Salesmen Needed to Replace 'Lazy Order-Takers'

Special to NPN

LAKE DELTON, Wis. — One of the greatest needs of oil marketing is for salesmen who can sell to replace or supplement the efforts of men who became confirmed "order takers" during the wartime seller's market.

This information was forthcoming in conversation with jobbers, independent refiners and major company men between swats at golf balls during the Wisconsin Petroleum Assn.'s 10th annual gold tournament and stag party, held here on June 18.

"Anything you need today?" is the usual approach of the order-taker.

"Nope!" is the usual customer reply.

"O.K.! See you next trip"—and the order taker is on his way.

That attitude won't get the job done, according to Dewey E. Foster, president of Wisconsin Oil Refining Co., this state's only refiner. Mr. Foster said he has tried out four or five new men as salesmen since V-J Day, but they did not work out.

"The failures with me were lazy mentally," he said. "I think there is now a demand for good salesmen by all oil companies. During the war even the older help became order-takers, and now we have to sell to get the business, even though the demand is heavy."

All eight of the men who went to war from Wisconsin Oil Refining Co. have returned to their jobs, and are quite happy to be home again, Mr. Foster said. Most of them are married and are doing operational work, however. None are in sales.

Joe Johnson, Lion Oil Co., Texaco jobber at Janesville, declared many men in oil marketing do not have their minds on business. Mentally, they are still roving and restless as result of their travels incident to military service or moving from one job to another at war plants. There are from 115 to 120 men employed at the four bulk plants Mr. Johnson operates and the 46 service stations he serves, 25 of the men having been employed since V-J Day. Sales of all products during May totaled 250,000 gals., the biggest May in the company's history, but not the biggest month which was in September, 1941, when sales totaled 275,000 gals., Mr. Johnson said.

Clarence Siemann, Siemann Oil Co., Skelly jobber at Menominee, Mich., said that he has employed but one new man during the past year. He is a truck driver at the bulk plant and is working out all right. He is an older man. However, one of his lessee dealers who spent 1½ years in military service in Europe returned to his station March 14, and is also doing satisfactorily.

Mr. Siemann is doing a complete clean-up job by repainting his bulk plant storage tanks, Skelgas appliance warehouse and three service stations. He has handled Skelgas since 1940, and says that drums are still very scarce.

I. C. Turner & Son, Phillips jobbers at Baraboo, Wis., are expanding into the fuel oil market. They are adding a new 20,000-gal. tank to their storage facilities, which will total about 100,000 gals., and will handle fuel oil for the first time during the coming season.

Asked what the solution was to problem of getting better salesmen, consensus was a little more time for mental reconversion—summer vacation and an increase in income for the salesman. A major company division sales manager explained that the big companies are in the same fix for salesmen as the jobbers and independent refiners.

GASOLINE CONSUMPTION BY STATES, MARCH 1946

	Tax Rate† March Cents	Month of Feb., 1946 Gallons	Month of Mar., 1946 Gallons	Month of Mar., 1945 Gallons	Change %	3 Months Ending With Mar., 1946 Gallons	3 Months Ending With Mar., 1945 Gallons	Change %
Alabama	6	27,645,000	31,548,000	24,055,000	+31.15	87,521,000	70,370,000	+24.37
Arizona	5	13,044,000	14,009,000	10,025,000	+39.74	40,287,000	28,934,000	+39.24
Arkansas	6½	•18,242,000	21,810,000	15,513,000	+40.59	58,863,000	45,742,000	+28.68
California	3	226,228,000	255,657,000	207,074,000	+23.46	703,241,000	595,694,000	+18.05
Colorado	4	19,736,000	25,237,000	26,333,000	— 4.16	65,898,000	69,194,000	— 4.76
Connecticut	3	23,997,000	28,536,000	23,304,000	+22.45	78,637,000	64,985,000	+21.01
Delaware	4	4,433,000	5,333,000	4,200,000	+26.98	14,463,000	11,016,000	+31.29
District of Columbia	3	10,560,000	11,798,000	9,317,000	+26.63	33,829,000	26,773,000	+26.35
Florida	7	47,625,000	50,519,000	36,296,000	+39.19	146,249,000	102,066,000	+43.29
Georgia	6	40,941,000	44,730,000	33,462,000	+33.67	127,668,000	93,355,000	+36.76
Idaho	6	7,598,000	9,960,000	7,545,000	+32.01	25,207,000	19,407,000	+29.89
Illinois	3	100,392,000	127,569,000	100,746,000	+26.62	331,752,000	260,288,000	+27.46
Indiana	4	54,878,000	66,675,000	60,563,000	+10.09	183,592,000	167,769,000	+ 9.43
Iowa	4	42,795,000	50,857,000	47,079,000	+ 8.02	137,437,000	114,787,000	+19.73
Kansas	§4	54,621,000	33,327,000	37,726,000	—11.66	123,578,000	95,476,000	+29.43
Kentucky	5	27,564,000	32,455,000	27,352,000	+18.66	87,867,000	82,475,000	+ 6.54
Louisiana	7	26,107,000	29,712,000	21,812,000	+36.22	83,544,000	71,164,000	+17.40
Maine	4	10,111,000	12,264,000	11,107,000	+10.42	33,317,000	29,605,000	+12.54
Maryland	4	23,845,000	29,054,000	28,561,000	+ 1.73	79,276,000	80,855,000	— 1.95
Massachusetts	3	45,289,000	55,497,000	47,689,000	+16.37	153,292,000	131,633,000	+16.45
Michigan	3	87,284,000	103,721,000	95,361,000	+ 8.77	286,327,000	266,696,000	+ 7.36
Minnesota	4	36,594,000	44,798,000	37,270,000	+20.20	122,440,000	98,427,000	+24.40
Mississippi	6	20,325,000	25,845,000	16,479,000	+56.84	65,927,000	49,103,000	+34.26
Missouri	2	52,451,000	64,975,000	44,632,000	+45.58	173,223,000	125,358,000	+40.58
Montana	5	7,973,000	12,533,000	9,002,000	+39.22	29,336,000	22,362,000	+31.19
Nebraska	5	20,231,000	24,067,000	20,589,000	+16.89	65,615,000	53,332,000	+23.03
Nevada	4	3,802,000	4,191,000	3,891,000	+ 7.85	11,546,000	10,397,000	+11.05
New Hampshire	4	5,982,000	6,878,000	5,688,000	+20.92	19,310,000	15,576,000	+23.97
New Jersey	3	61,561,000	69,829,000	60,838,000	+14.78	195,135,000	167,116,000	+16.77
New Mexico	5	•10,980,000	12,682,000	9,734,000	+30.29	35,343,000	27,333,000	+29.31
New York	4	120,137,000	142,825,000	118,600,000	+20.43	391,320,000	316,163,000	+23.77
North Carolina	6	42,937,000	53,497,000	34,530,000	+54.93	144,399,000	98,066,000	+47.25
North Dakota	4	6,243,000	13,850,000	13,139,000	+ 5.41	28,917,000	28,763,000	+ .63
Ohio	4	98,415,000	124,188,000	119,903,000	+ 3.57	335,455,000	314,946,000	+ 6.51
Oklahoma	7½	35,418,000	40,413,000	51,474,000	—21.49	111,338,000	140,861,000	—20.96
Oregon	5	23,302,000	26,957,000	19,573,000	+37.73	73,391,000	53,853,000	+36.28
Pennsylvania	4	105,948,000	125,439,000	97,727,000	+28.36	344,862,000	262,286,000	+31.48
Rhode Island	3	•8,692,000	10,243,000	9,910,000	+ 3.36	128,133,000	29,560,000	— 4.83
South Carolina	6	21,804,000	24,656,000	18,678,000	+32.01	168,846,000	53,403,000	+28.92
South Dakota	4	9,039,000	13,141,000	11,097,000	+18.42	33,434,000	30,347,000	+10.17
Tennessee	7	31,673,000	43,808,000	25,127,000	+74.35	108,341,000	78,275,000	+38.41
Texas	4	155,042,000	208,554,000	416,497,000	—49.99	541,694,000	1,173,459,000	—53.84
Utah	4	8,884,000	10,702,000	7,933,000	+34.90	29,607,000	23,643,000	+25.23
Vermont	4	4,363,000	5,000,000	4,289,000	+16.58	14,057,000	10,200,000	+37.81
Virginia	5	37,741,000	44,001,000	41,969,000	+ 4.84	121,682,000	109,708,000	+10.91
Washington	5	33,811,000	38,667,000	29,539,000	+30.90	106,759,000	82,617,000	+29.22
West Virginia	5	16,182,000	20,470,000	12,436,000	+64.60	56,620,000	39,140,000	+44.66
Wisconsin	4	39,974,000	49,005,000	43,412,000	+12.88	136,624,000	116,601,000	+17.17
Wyoming	4	4,968,000	5,884,000	5,030,000	+16.98	16,700,000	16,134,000	+ 3.51
Total		1,937,407,000	2,307,296,000	2,164,036,000		6,292,399,000	5,975,313,000	
Daily Average		69,193,000	74,429,000	69,808,000		69,916,000	66,392,000	
Change from previous year:								
Total Change			+143,260,000			+317,086,000		
Percentage change in Daily Average			+6.61%			+5.31%		

• **Revised.**
§ Tax rate increased one (1) cent March 1st.
‡ January 1946 revised.
† **These are State tax rates per gallon. In addition there is the Federal tax of One and one half cents (1½c) per gallon.**

CLASSIFIED

For Sale

FOR SALE: One three compartment, 4000 gallon Progress Trailer with 1944 GMC truck tractor attached, price $3500. Also have two or three smaller semi-trailers for sale. If interested phone, write or wire Tennessee Oil Company, Dyersburg, Tennessee.

TRUCK FOR SALE — One new heavy duty FWD truck, 6x6 drive, extra long chassis and cab with winch, wheel base 246 inches, overall length 374 inches, Hercules engine IHB 559 cubic inches, air brakes, 12.00x20 tires. Hoeffken Bros., Belleville, Illinois.

FOR SALE: Fruehauf semi, 875 gallon capacity, including one 50 gallon kerosene compartment. Fifth wheel. Job in good condition. Two tires fair, two tires very good. $500.00 f.o.b. Milford, Delaware, where same can be inspected. Cox Distributing Company, Easton, Maryland.

GASOLINE STATION WITH BULK STORAGE, six room house 500 ft. frontage, four acres land, private railroad siding, two cabins, one storage tank 15,000 gallons, one storage tank 23 000 gallons split 11,500 each compartment. On route 5, one mile east of Auburn, N. Y. Suitable for retail and wholesale business. Price $16,000. Martin Oil Co., Camillus, N. Y.

FOOT VALVES

Immediate delivery on 1½" double-poppet all bronze. Write for prices

INDEPENDENT PUMP COMPANY
1250 Getty Street, Muskegon, Michigan

ALWAYS GET ISP's QUOTATIONS TOO!
USED TANK CAR TANKS
For Liquid Storage
6000 to 10,000 gallons
HEAVIER SAFER CHEAPER
CLEANED TESTED PAINTED
Also, Vertical Tanks of All Capacities
IRON & STEEL PRODUCTS, INC.
41 years' experience
13456-A S. Brainard Avenue
Chicago 33, Illinois
"ANYTHING containing IRON or STEEL"

FOR STORAGE

TERMINALING AND DISTRIBUTION
NEW 55,000 BBL. STEEL WELDED TANK
NEW 10,000 BBL. STEEL WELDED TANKS
Situated Chicago District
River Barges and Lake Tankers Can Be Unloaded and Loaded.
Rail Siding — Truck Loading

LAKE RIVER TERMINALS
624 S. MICHIGAN AVE.
HARRISON 3500
CHICAGO 5, ILL.

FOR IMMEDIATE DELIVERY

Propane TANKS Butane

150 gallon to 1000 gallon complete with fittings.

We design and erect L. P. Gas Bottling Plants.

Municipal L. P. Gas—Air Plants.

KENNEY TANK INSTALLATION CO.
2132 N. Halsted St., Chicago 14, Ill.

For Sale

TANK TRUCK for sale, 1936 Stewart truck with 600 gallon three compartment tank and Tokheim portable pumping unit with 100' fuel oil hose. $700.00. Webaco Oil Co., Inc., Webster, N. Y.

FOR SALE

Available for immediate delivery 3 late model 4300 gallon standard steel transports in perfect condition. Also 2 late model 5200 gallon tandem trailers in perfect condition.

LITTLEJOHN EQUIPMENT COMPANY
Box 952, Spartanburg, S. C.
Telephone 4081

FOR SALE

2 model WA-22 White tractors complete with 4300 gallon standard steel trailers in extra good condition. 1 model WA-20 White tractor with 4250 gallon Heil trailer in good condition. All equipment is clean and does not need any type repairs.

LITTLEJOHN EQUIPMENT COMPANY
Box 952, Spartanburg, S. C.
Telephone 4081

FOR SALE

One 1941 Butler semi-tank, 3225 gallon capacity, three compartment with valve compartment on side. One 1941 Ford Tractor, two speed axle, 825-20 tires. These units in No. 1 condition. Will not sell separately. Write

OLD DUTCH REFINING CO.
H. O. Forquer
Box 418, Muskegon, Mich.

For Sale

FOR SALE

7 Model #323 Neptune printing registers suitable for loading rack meters in bulk plant. This equipment has had very little use, and is in excellent condition. Price, $50.00 per unit.

BOX 64

TANKS

12—New 1000 bbl., 42,000 gal., 21' 6½" dia. 16' High bolted tanks with roof—In stock.

L. M. STANHOPE
Rosemont, Penna.

FOR SALE

One 3094 gallon, five compartment Dorsey tank trailer. Manifold, four good 1000 x 20 tires. One 1942 Ford 100 H. P. truck with tank if desired.

C. C. MURPHY, JR.
Box 216, Abbeville, Alabama

FOR SALE GASOLINE TRANSPORT

3,850 gallon capacity two compartments, 1000 x 20 tires; Westinghouse air brakes. $1,000.00.

STATE OIL COMPANY
2120 Locust St., St. Louis, Mo.
Chestnut 0370

Wanted to Buy or Lease

WANTED TO BUY OR LEASE

Gasoline service stations in Indiana, Illinois, Michigan and Wisconsin.

Trackside stations, stations with large tanks, stations that can be served economically from bulk plants.

Locations must be on heavy traffic flow streets or highways, or in large centers of population.

Box 58

CLASSIFIED

Wanted to Buy

WANTED: Gasoline delivery four to six compartment tank of between 800 and 1000 gallon capacity. Write: Lewis Oil Company, Hillsdale, Michigan.

WANTED

Storage tanks 100,000 to 500,000 gallons capacity. Must be in good condition.

EMPIRE EQUIPMENT CORPORATION
608 Empire Bldg., Cleveland 14, Ohio
Phone: MAin 7667

WANTED

Jobbing or commission operated business selling a good product, having trucks and installed equipment. Maybe your health would indicate selling. All replies held in strictest confidence. Prefer either of the Virginias or Carolinas.

Box 61

STEEL DRUMS

We buy and sell used empty steel drums at any point. Let us have your offerings. We also sell reconditioned drums.

BUCKEYE COOPERAGE COMPANY
3800 Orange Ave. Cleveland 15, Ohio
Phone Express 3383

WANTED

Four gasoline wheel carts, good condition. State price.

WELLS PETROLEUM CO.
816 Haines St., Chicago 22, Ill.

SEMI-TRAILER

Three compartments, capacity from 4000 to 4200 gallons, air brakes, must be clean and in good condition.

SOUTHERN OIL CO. OF N. Y., INC.
Horseheads, New York

For Sale or Lease

BULK PLANT sale or lease. Large lot on railroad siding. Summit County, Ohio. Write Box 63.

For Lease

FOR LEASE

Southern Canning or Barreling Plant Site. Brick building with inside elevated storage tanks, railroad siding, etc. Write, wire or call:

C. E. LEPLEY
P. O. Box 808, Charleston, S. C.
Phone 4420

Business Opportunity

WANT TO INVEST Capital and Experience in established Industrial Laboratory. Will consider purchase, lease or part ownership. Box. 62.

Situations Open

INDUSTRIAL LUBRICATION ENGINEER wanted by expanding middle western major oil company. Splendid opportunity for one who has experience and who can sell. State salary and qualifications. Box 55.

Situations Open

WANTED

CHIEF CHEMIST — ASPHALT EXPERIENCE

Independent mid-continent refiner has permanent position open for experienced oil refinery chemist. Salary open. Give full particulars in first letter.

BOX 56

ENGINEERS

Instrument Specifications—Man qualified to select, size and write specifications for all OIL REFINERY instruments including relief and control valves; also check and approve manufacturers' certified instrument drawings.

Equipment Specifications—Man qualified to write specifications for OIL REFINERY equipment such as pumps, heat exchangers, condensers, compressors, vacuum equipment, etc; also check and approve manufacturer's certified equipment drawings.

Two qualified engineering designers on OIL REFINERY pressure vessels.

Our regular work week is 40 hours; time and one-half is paid for work over 40 hours; good working conditions; opportunity for permanency and advancement; pay for recognized holidays falling within work week.

State your qualifications, experience record, salaries earned and desired or write for application form.

ARTHUR G. McKEE & CO.
2300 Chester Ave.
Cleveland, 1, Ohio

MANUFACTURERS AGENT

Excellent opportunity for commission agent calling on jobbers and dealers in petroleum marketing and/or L-P Gas equipment. For the past eight years, Rectorseal thread and gasket sealing compound has been universally recognized and widely used in all Mid-Continent petroleum producing areas, and is now available for distribution through established channels to the marketing trade. Exclusive territory and generous commission to qualified party. Give past experience and particulars regarding lines now handled and territory covered in first letter.

RECTOR WELL EQUIPMENT COMPANY, INC.
2215 Commerce St. Houston 2, Texas

PLANT FACILITIES

REFINERY FACILITIES AVAILABLE

Here is an unusual opportunity for anyone who makes, buys or sells lubricating oils or greases. Major oil company with large modern refinery in Philadelphia Harbor offers the facilities of its plant to responsible firms. Up-to-date equipment and trained personnel capable of manufacturing, compounding, packaging, storing and shipping lubricating oils and greases are available now. Plant has deep water docking facilities and railroad siding. For further information, write to

BOX 65

Professional Service

RESEARCH
On Contract Basis
J. BJORKSTEN, PH. D.
Chemists
185 N. Wabash Ave. Chicago 1, Ill.

ACCURATE LABORATORY TESTS
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ADVERTISERS' INDEX

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American Flange & Mfg. Co. 4
Birmingham Tank Co. 38
Blackmer Pump Co. 48
Brown Steel Tank Co. ..... Inside Back Cover
Chicago Bridge & Iron Co. ..... Facing 24
Cities Service Oil Co. 23
Continental Can Co. 49
Erie Meter Systems, Inc. ..... Inside Front Cover
Ethyl Corp. 1
Fruenauf Trailer Co. 32, 33
Gulf Oil Corp. 47
Industrial Raw Materials Corp. 50
Ingalls Iron Works Co. 38
Kellogg Co., M. W. 6
Kidde & Co., Inc. Walter 43
Mack Mfg. Corp. 41
Mid-Continent Petroleum Corp. 29
National Petroleum News 50, 62
Neptune Meter Co. 2
Pennsylvania Grade Crude Oil Assn. 59
Petroleum Solvents Corp. 28
Purolator Products, Inc. 31
Richfield Oil Corp. of N. Y. 39
Scully Signal Co. 44
Stanco Distributors, Inc. (Perbunan) 8
Sun Oil Co. ..... Outside Back Cover
Timken-Detroit Axle Co. 45
U. S. Industrial Chemicals, Inc. 35

ABOUT OIL PEOPLE

Madison Gas and Oil Co., Madison, Wis., is now distributing Tidewater . . . **Vic Comstock** heads the company.

° ° °

Hewett Oil Co. (formerly Batson Hewitt Oil Co.) Charleston, S. C., will add seven super service stations to the present 25 outlets when building restrictions are lifted . . . Company, recently granted a charter under its new name, $150,000 capital stock, is headed by **Batson L. Hewitt** as president; **Ann Hewitt,** vice president; and **John H. White,** secretary-treasurer . . . Hewett flys the Pure Oil banner . . . Home freezers, toasters and radios are among items marketed by this independent, which wholesales TBA items.

° ° °

Gulf Refining Co. has purchased Crest Oil Co. at Cincinnati . . . deal included 18 stations. Barnard Markstein, former owner, is back in the distilling business.

° ° °

Drake and Mills Oil Co., Syracuse, N. Y. has added distribution of G. E. burners to its line . . . Franchise comprises five counties in the Syracuse district . . . **E. C. "Ducky" Drake** is president.

° ° °

Columbus Oil Co., Charlotte, N. C. is now flying the Richfield colors over 70-odd outlets in the Tar Heel state. **Charles C. Beasley** is president.

° ° °

Gene Lowell Williams, engaged with his father, **Russell S. Williams,** in operating Gaseteria, Inc., Indianapolis, was married to Ruth Elizabeth Fetscher, Park Ridge, Ill., on June 22.

° ° °

Fred Lehning of Susank Oil Co., Hoisington, Kans., has added a car agency to his enterprises.

° ° °

A fuel oil and burner sales business has been added to Townsend Oil Co., Le Roy, N. Y. **Elbert Townsend** is president and owner of the company.

° ° °

The Forest Park Oil & Appliance Co. has been organized in Kenosha, Wis. to deal in petroleum products . . . **Paul Kempien, Robert Van Benegom, Arthur Hubbard** and **J. P. McEvay** are the organizers.

° ° °

Golden State Oil Co., San Diego, Cal., is now operating as Fogerty Oil Co. . . . **Fred J. Fogerty** is the owner . . . Signal products are distributed.

° ° °

Ohio Petroleum Marketers Assn. is making plans for a silver anniversary celebration next May . . . It will be held in conjunction with the organization's annual convention and marketing exposition . . . Tentative dates are April 29 and 30 and May 1.

° ° °

Another lusty oil jobbing business has been born in Caroleen, N. C. . . . The company, **Lutz and Champion,** is operated by two returned veterans . . . they are distributing Crown Central products.

° ° °

Fred H. Meeder, Richfield's general superintendent of terminals, announced that the new superintendent of the Schenectady, N. Y. terminal is **William H. Switts** . . . same day he revealed that the stork had presented Mrs. Meeder with a 7 lb. 11 oz. daughter, Edith Ann.

° ° °

James J. Cosgrove, vice president and general counsel of Continental Oil Co. who was elected chairman of the board recently (see NPN June 12, p. 6), has assumed his new duties.

Mr. Cosgrove

Formerly a lawyer, Mr. Cosgrove practiced in Pittsburgh until 1917 when he entered the Army. After the armistice he became a member of the War Department Board of Appraisers and later a member of the Claims Board. In 1921 he was named special attorney to the Internal Revenue Commissioner and the following year began his oil career with The Texas Co. He joined Continental in 1929.

° ° °

N. R. Grimshaw retired on company annuity May 29 as manager of Standard of Indiana's South Bend sales field after more than 40 years of service.

C. C. Inglefield, assistant manager at South Bend will be promoted to succeed Mr. Grimshaw and **M. E. Crow,** sales manager at Indianapolis will be advanced to succeed Mr. Inglefield.

Mr. Grimshaw joined Standard of Indiana in 1906 in Detroit as a salesman. In 1921 he served as assistant general manager with headquarters in Chicago and in 1938 became manager at South Bend.

Mr. Inglefield began with the company in 1916 in the Chicago sales division and in 1924 was transferred to Chicago general office. In 1929 he was made salesman at Grand Rapids, Mich., and promoted to assistant manager at Joliet, Ill., in 1931. In 1935 he was transferred to the same position at South Bend.

Mr. Crow joined Standard in 1933 as agent at Joliet where he advanced to sales manager. In 1944 he was transferred to same position at Indianapolis.

° ° °

Allan R. Smith has been appointed executive secretary of National Truck Tank and Trailer Tank Institute and of Steel Tank Institute. Headquarters for both associations will continue in Chicago.

Mr. Smith succeeds J. E. Julian, former president of both groups, who died last January. Prior to his present undertaking, Mr. Smith had been for four years assistant secretary of Wirebound Box Manufacturers Assn.

° ° °

A. A. Stambaugh, vice president and general sales manager for Standard Oil Co. (Ohio), has been re-elected vice president of the American Management Assn. He will head the marketing division of the association. American Management Assn. is composed of a group of more than 9000 industrial companies and executives.

° ° °

W. P. McGinnis, for many years a member of the Cities Service Oil Co.'s legal department at Fort Worth, has retired to a ranch near Denton, Tex.

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NATIONAL PETROLEUM NEWS

1213 West 3rd Street . . Cleveland 13, Ohio

ABOUT OIL PEOPLE

As result of expanded activity in The Carter Oil Co. laboratory, Tulsa, research responsibilities have been realigned.

Dr. P. S. Williams, chief of research, is in charge of divisions devoted to exploitation research, geophysical research, geological research and development engineering. **Dr. Eugene M. McNatt** is in charge of geophysical research, **Dr. William A. Bruce** directs exploitation research, **Dr. Parke A. Dickey** heads the geological research work, and **F. G. Boucher** supervises development engineering.

° ° °

Hoping to be back at the office this week is **J. B. Smith,** vice president in charge of sales for Vickers Petroleum Co., Wichita, who injured his back while working on the cedar trees in his back yard and had to spend last week in bed.

° ° °

John T. Hayward, vice president of Barnsdall Corp., has been awarded the Distinguished Civilian Service Award "for outstanding service to the United States Navy while serving as senior technical aide at the U. S. Naval Mine Warfare Test Station at Solomons, Md., from October, 1943, until the cessation of hostilities." His most outstanding contribution to naval ordnance, the citation stated, was the basis of a new underwater weapon now in the final stages of development and testing.

A native of England, Mr. Hayward was graduated from Liverpool University where he studied marine engineering. He came to the United States to live in 1929, and has been with Barnsdall for the past 15 years.

° ° °

Herbert Willetts has been made manager of the central marketing region of Socony-Vacuum Oil Co., Inc. **J. M. Martin** assumes Mr. Willett's former position as manager of the eastern marketing region.

° ° °

Robert G. Dunlop, comptroller of Sun Oil Co., has been re-elected director of the Philadelphia Control of Controllers Institute of America.

° ° °

Dr. Parke A. Dickey, formerly with Quaker State Oil Refining Corp. at Bradford, Pa., has been named director of the geological phase of research activity at the Tulsa laboratory of the Carter Oil Co.

A graduate of Johns Hopkins university in 1932, Dr. Dickey spent several years in South America with Tropical Oil Co. Later he was associated with Pennsylvania Geological Survey and with Forest Oil Co.

A. C. Long has been named assistant to the vice president of foreign operations department of The Texas Co.

Mr. Long formerly was manager of executive sales division of Texas Co.'s foreign sales department. He has been with Texaco since 1930 and has served in various capacities in foreign and domestic operations, chiefly in sales.

Mr. Long

In 1941 Mr. Long left the company on military leave of absence and spent 14 months in government service. During much of that time he was petroleum attache for State Department in London.

Texas also has made **Franz von Schilling** assistant manager of European and African divisions of foreign sales department. He has been with Texaco since 1924 and during World War II served in the Navy.

° ° °

R. N. Duncan has been appointed manager of the supplies department, Shell Oil Co., Inc., New York. He started to work for Shell in 1927 as a clerk in the cracking department at the company's East Chicago, Ind., refinery. In 1933 he became senior clerk in the manufacturing department. He moved to New York in 1940 as head supply and statistical clerk in the supplies department and later became acting manager.

° ° °

After more than five years in Washington as executive assistant to Deputy PAW and Acting OGD Davies, **H. Chandler Ide** is leaving the capital city this week to enjoy a long rest in his home state of California. Mr. Ide came to PAW (then OPC) from California Standard in mid-1941 and served throughout the war period and beyond as a valued aide to the deputy administrator. His future plans are indefinite.

° ° °

This is the season when golf tournaments are in full swing in the Midwest and oil men in unusual numbers are taking to the fairway.

At the Wisconsin Petroleum Assn.'s 10th annual tournament, Lake Delton, Wis., June 18, attended by 155, of whom 61 played golf, three players came in with an 80-stroke tie for first low gross. In a toss-up for choice of first prize, **Ted Bost** of Pennsylvania Oil Co., Madison, won; **Roy Jacobs,** Ahrens Oil Co., Mukwonago, got second choice and **Mel Teige,** Wisconsin Petroleum Co., Stoughton, third choice.

In the low net score classification, E. **Terwilliger** of Bailey Oil Co., captured first prize with a 65; **E. T. McGovern,** second prize with a 67, and **Glenn Keister,** Shell, Chicago, third prize with a 69.

Orlin Emerson, Emerson Oil Co., Waukesha, held the lucky number and won first draw prize, a portable radio.

In the competition match between Wisconsin players and visiting Chicagoans, the Wisconsin foursome won.

° ° °

George F. Falley, president, Falley Petroleum Co., Chicago, was recently elected president of Northwestern University Alumni Association. Mr. Falley was formerly vice president in charge of the Century Fund, a special fund of cash donations to be turned over to the university at its centennial celebration in 1951.

° ° °

Frank E. Spencer, manager fuel oil division, Socony-Vacuum Oil Co., former president of the Northwestern Alumni Association in 1942-43, is now serving his third year as trustee of the university.

° ° °

Lester F. Danforth has been appointed director of Arkansas Oil & Gas Commission. He succeeds **E. M. Dutton,** who resigned May 15 to enter private business in Brownwood, Tex.

Mr. Danforth

Mr. Danforth served in the Army, entering service May 25, 1943, with the rank of first lieutenant, attaining the rank of major before his discharge in April of this year. From February to October, 1944, he was in Operations Branch and Statistical Section of Fuels and Lubricants Division, OQMG. He was overseas from October, 1944, to January, 1946: first, in New Quinea where he was in charge of procurement and distribution of petroleum for the ground forces and later in the Philippines where he was chief requirements officer, responsible for all petroleum products required by the Navy and Air Corps.

He began his oil career in 1930 as production engineer with Deep Rock Oil Corp. In 1932 he went with Pure Oil Co. where he remained until 1934 when he became treating engineer with Dowell, Inc. From 1935 to 1942 he was employed by Halliburton Oil Well Cementing Co., first as treating and cementing engineer and later as assistant superintendent of the Kansas District.

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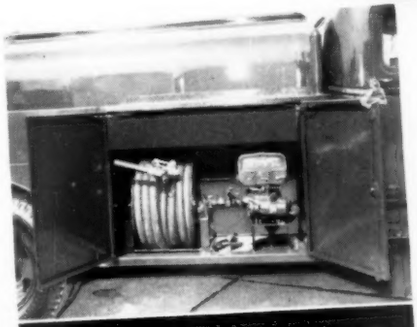

Enclosed cabinet houses hose reel, Meter and air eliminator.

Rear view of truck tank showing full length hinge on doors and hinged bumper.

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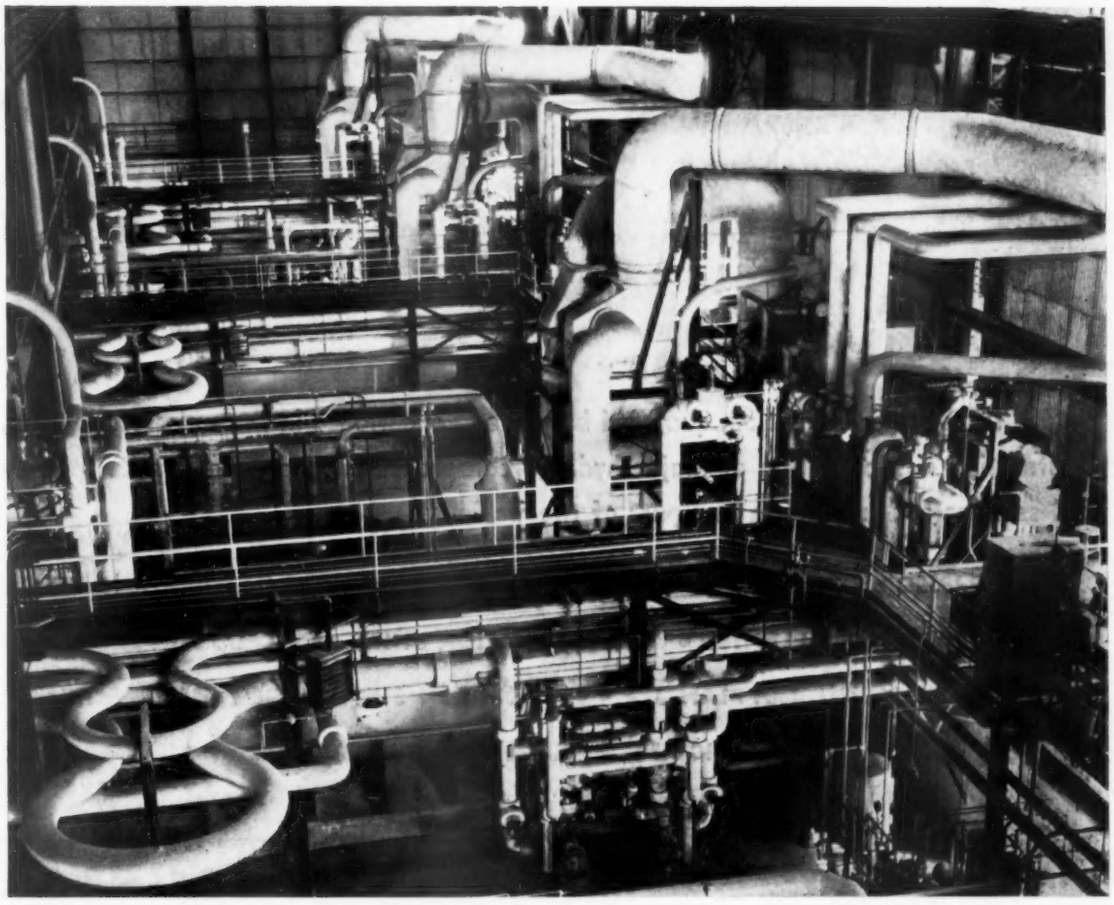
NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to

REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

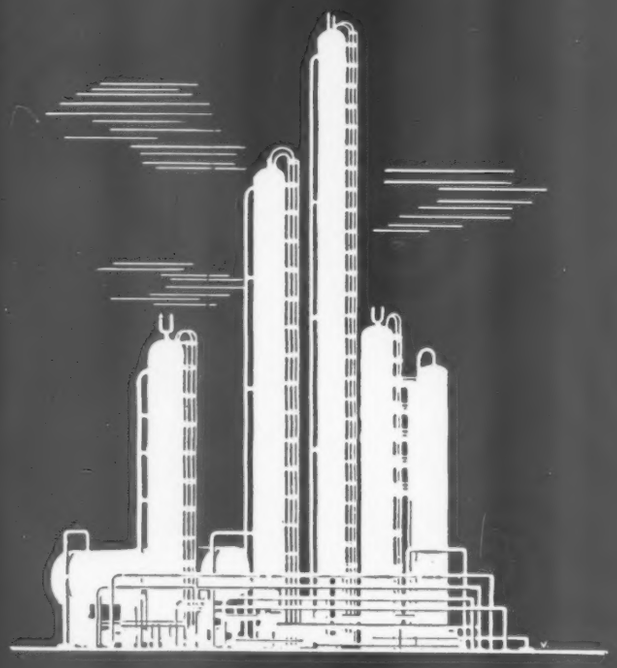
Section Two | July 3, 1946 | Vol. 38, No. 27



PETROCHEMICAL OPERATION: View looking down on the massive piping and furnaces of the secondary reform unit in the chemical plant of Lion Oil Co., at El Dorado, Ark. This plant, unique among oil company operations, manufactures ammonium nitrate for fertilizer, and other ammonia products, from natural gas. See detailed article on page R-483.

ALSO IN THIS ISSUE:

Fibrous Glass Desalts Crude Without Use of Chemicals . . . . page R-492
New Hydrocol Process Makes Motor Fuel from Gas . . . . . page R-506
Analyzing Additive Lubricants in Minutes . . . . . page R-519



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Contents

National Petroleum News, TECHNICAL SECTION

Vol. 38, No. 27—July 3, 1946

Refinery Equipment

New Method for Removing Salt from Crude Uses Fibrous Glass, Requires No Chemicals R-492

Plant Practices . . . for Refinery Superintendents and Foremen ..... R-497 ★

Mechanical Barrel Washer 'Launders' 60-80 Drums an Hour—Turns Them out Ready for Painting ..... R-502 ★

Plant Operation

Chemicals Present in Escaping Wastes Can Damage Waters for Many Uses (No. 7 in a series) ..... R-512 ★
By W. B. Hart

Analyze Additive Lubricants in Minutes Instead of Hours With Spectrographic Method ..... R-519 ★
By L. E. Calkins and M. M. White

Plant Design

Principles of Reactor Design
Article 3—Dehydrogenation of Normal Butane R-545
By R. H. Dodd and K. M. Watson

Refining Processes

Fertilizer from Natural Gas ..... R-483 ★
By D. P. Thornton Jr.

The New Hydrocol Process ..... R-506 ★
By P. C. Keith

Chemicals from Propane R-531
By J. E. Bludworth

Departments

Technical Meetings for Oil Men R-481

Tomorrow in Petroleum Technology ..... R-489 ★

Patent Trends in Petroleum Refining ..... R-538 ★
By Peter J. Gaylor

Petroleum Technologists in the Headlines R-558

Widening Horizons ..... R-560 ★
"Technology at Work to Insure True Conservation of Natural Gas"

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V. B. Guthrie, Editor, Technical Section

D. P. Thornton, Jr., Assistant Editor • William F. Bland, Engineering Editor

PREVIEWS

Waste Disposal Is Current Topic Of Conversation Among Refiners

Everywhere we turn we hear more about the pressing problem of properly disposing of refinery wastes. One refiner tells us that he has had his plant inspected twice in the past month by state pollution officials—who threw searching glances at both the oil-water separator effluent and the smoke from the flare stack.

Last month the W.P.R.A. held a regional technical meeting at Lansing, Mich., and L. C. Burroughs of Shell told the nearly 50 refiners assembled that they were going to find it "more and more important that strictest attention be directed to the control of waste materials."

The month before, W. B. Hart of Atlantic talked for more than two hours on the subject before a similar meeting of the National Petroleum Assoc.

Mr. Hart, the dean of refinery waste disposal experts, is author of the current series of articles on the subject now appearing in the NPN Technical Section (p. R-512 this month). Mr. Hart tells us that he has one main fear in connection with the rush by refiners to do something about wastes—and that is that what they do "will be either wrong, inadequate, or in excess of what is necessary." His belief is that they should first have a clear understanding of just what their wastes are doing, and that only then will they know what needs correction, how far it should be corrected, and what equipment will best do the job.

One bright spot on the horizon is that refiners may have some respite from new federal controls. Even though the latest of several anti-pollution bills now pending in Congress (H.R. 6024 introduced in April by Representative Mansfield of Texas) is said to have priority on the legislative agendum, odds are that it will not clear both houses this year.

TECHNICAL MEETINGS FOR OIL MEN

August

25-28, American Institute of Chemical Engineers, western convention, Palace Hotel, San Francisco.

September

9-13, American Chemical Society, 110th meeting, Chicago.

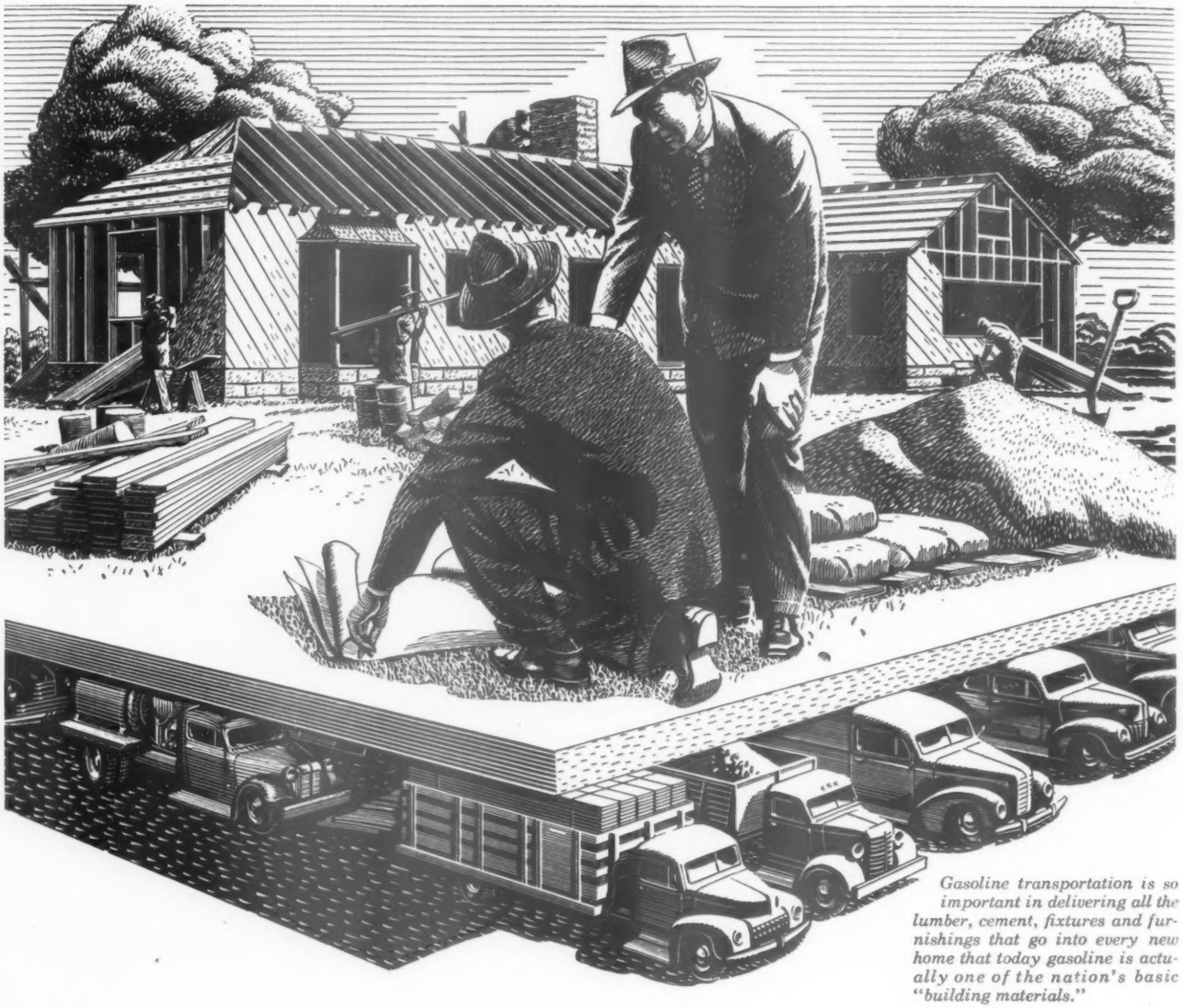
10-14, 4th National Chemical Exposition, Coliseum, Chicago.

16-20, National Instrument Conference, sponsored by Instrument Society of America, Wm. Penn Hotel, Pittsburgh.

18-20, National Petroleum Association, 44th annual meeting, Hotel Traymore, Atlantic City, N. J.

October

7-12, American Gas Association, annual meeting, Atlantic City, N. J.



Gasoline transportation is so important in delivering all the lumber, cement, fixtures and furnishings that go into every new home that today gasoline is actually one of the nation's basic "building materials."

Houses are built on gasoline

BUILDING is an assembly job. Before a house can be put together, it has to be brought together—lumber, bricks, cement, pipes, pre-fabricated sections and other materials delivered to its site by motor truck. Better, faster automotive transportation helps builders do a better job—just as it helps the people in every other industry and business.

Over the years the nation has benefited from many improvements in gasoline transportation. Through improved refining methods and the use of antiknock fluid made by Ethyl, oil companies have produced increasingly better gasolines. And each advance in gasoline quality has made possible the design of more powerful, more efficient engines for automotive vehicles of every kind.

The quality of gasoline generally available at filling stations is a big determining factor in the design of automobile engines for any particular year. If gasoline progress should for any reason be retarded, progress in the entire field of automotive transportation would suffer. But as long as refiners are able to supply the nation with finer fuels, the automotive industry will make sure that America receives the benefits of better transportation at lower cost. Ethyl Corporation, Chrysler Building, New York 17, N. Y.

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PETROLEUM CHEMICAL TECHNOLOGY

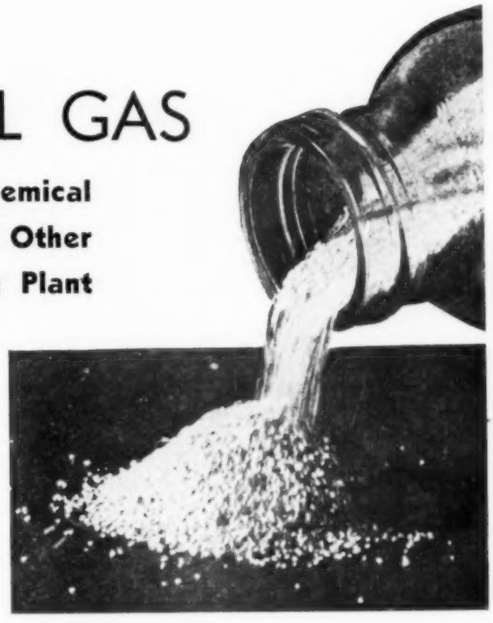
July 3, 1946
Volume 38
Number 27

MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

PETROCHEMICALS

FERTILIZER from NATURAL GAS

Independent Refiner Ventures into Petrochemical Field, Manufactures Ammonium Nitrate and Other Ammonia Products in Leased Government Plant



By D. P. Thornton, Jr.
Assistant Editor
NPN Technical Section

THE modern version of beating a sword into a plowshare, in a new world scientifically minded, is being enacted at El Dorado, Ark., under oil company direction and management.

Lion Oil Co., independent refiner, is manufacturing from natural gas ammonium nitrate fertilizer to increase the production of foodstuffs so direly needed over the world. A leased government plant, built and operated during the war to make ammonia for high explosives, has been converted to this peacetime operation.

The Lion company started operations May 13 of the plant at El Dorado formerly known as Ozark Ordnance Works, to manufacture ammonia, nitric acid and ammonium nitrate, amending its articles of incorporation to provide for its venture into this line of petrochemicals. Col. T. H. Barton, well known oil man of the Southwest, is president of Lion Oil Co.

Initial operations at the Lion chemical plant will be devoted to the production of ammonia and nitrogen fertilizer, materials which are vitally important to agriculture. To provide its own facilities for the production of a finished high-nitrogen content ammonium nitrate fertilizer a new unit will be constructed at the Lion chemical plant at a cost of approximately $1,000,000. However, no delay will be experienced in fertilizer materials production through awaiting the construction of this new unit, since Lion Oil has also leased for temporary use the ammonium nitrate graining facilities at Minden, La. and Texarkana, Texas.

The Lion chemical plant is favorably located with reference to the domestic fertilizer market. The area around El Dorado should constitute a ready market for crop nutrients. The plant is also located near large supplies of low-cost natural gas, which is very important, since natural gas is the only purchased raw material used at the Lion plant. It also has available at El Dorado a good labor market, excellent water, favorable climatic conditions and other factors which make it an ideal location.

Lion's research organization has been at work for many months studying possible avenues of expansion opened by Lion's lease of the Ozark Ordnance Works. Information on other products which Lion plans to produce in the future has not been made public; however, there should be little difficulty in adding equipment to produce methyl alcohol, formic acid or acetic acid from the by-product carbon monoxide or to make dry ice or various pharmaceuticals from chemicals available at the plant.

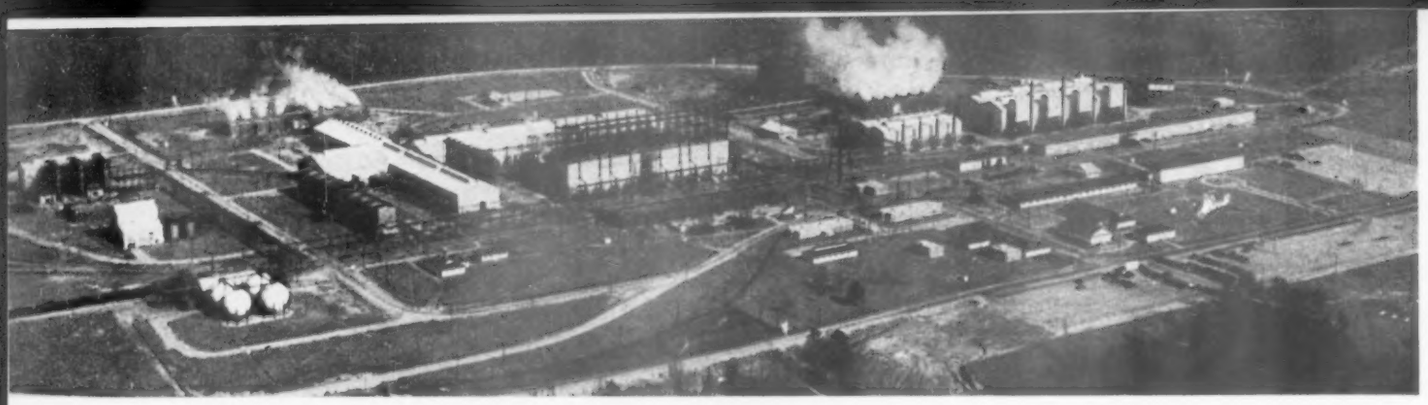
Ammonia itself is a compound of wide interest since it forms a starting point in the synthesis of an almost endless list of chemicals ranging from explosives to fertilizers through plastics, textiles, solvents, pharmaceuticals and detergents. By-products at Ozark, carbon monoxide and the dioxide, also are of industrial importance either as such or as intermediates in production of other chemicals for which ammonia may or may not be required as raw material.

Aside from the above products, other peacetime possibilities include the production of urea. This substance has several uses, many of them new developments which are expected to meet popular acceptance. Wood impregnated with a urea-formaldehyde combination becomes a very hard building and furniture material which is impervious to moisture and insect destruction. Urea-formaldehyde combinations have also found wide uses in the plastic industry. The formaldehyde required also could be produced at the Lion chemical plant.

The $25,000,000 Ozark Ordnance Works, one of eight ammonia plants constructed by the Government for war time production of ammonia, nitric acid and ammonium nitrate, was operated during the war by Lion Chemical Corp., a wholly owned Lion Oil subsidiary. The plant, built by the Army's Ordnance Department, occupies 3244 acres in the heart of a pine forest three miles north of El Dorado. One of its buildings, crammed with gas-driven generators and compressors, is said to be the largest compressor station under one roof in continental U. S.

Today this plant with its 15 miles of all-weather road, well designed and built process and administrative buildings, hospital, cafeteria, laundry, fire station and dormitory is capable of producing annually 165,000 tons of ammonium nitrate and 90,000 tons of anhydrous ammonia.

Under Lion's management the capacity of the plant was increased well above 150% of design capacity and it became one of the largest and the most economical producers of ammonia and



Chemical plant at El Dorado, Ark., built by Army Ordnance, now leased by Lion Oil Co. to make ammonia products from natural gas. Left foreground, ammonia spheres; left background, ammonia synthesis unit; right, reform units, gasholders, maintenance shops

ammonium nitrate of all the plants in the U. S. Three times the plant was awarded the Army-Navy "E" for production excellence.

Lion was in an excellent position to take over the government plant after the war since its personnel have been trained in plant operation since the day the first compressor turned over. In plant operation management has the enviable record of taking, as one engineer put it, "butchers, bakers and candlestick makers" who had never been in a chemical plant before—indeed most had no industrial operation experience whatever—and making them into efficient chemical plant operators. Machinists and maintenance men were in part recruited from the ranks of those who had some experience, but even here there was a lot of on-the-job learning.

The principal steps in making ammonium nitrate fertilizer from natural gas are:

1—Securing hydrogen from methane and steam, and nitrogen from the air.

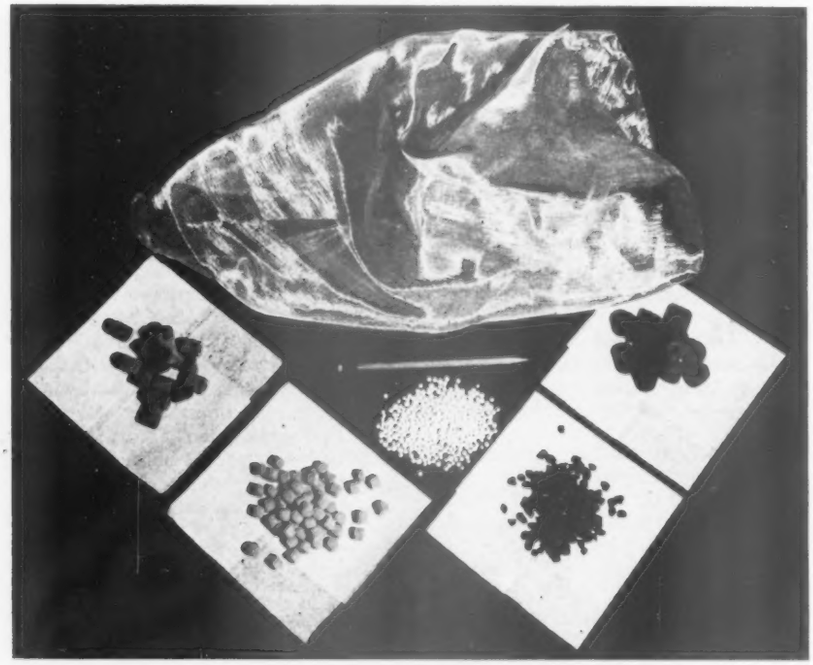
2—Purifying the hydrogen-nitrogen mixture by removing three unwanted materials: oxygen, carbon monoxide and carbon dioxide.

3—Reacting the hydrogen-nitrogen mixture to form ammonia.

4—Oxidizing part of the ammonia with air to form nitrogen dioxide, and absorbing the latter in water to form nitric acid.

5—Reacting equal parts of nitric acid and ammonia to produce ammonium nitrate liquor.

6—Dehydrating the ammonium nitrate liquor to recover the crystals, and forming them into shapes or "grains" convenient for agricultural use.



Various catalysts used at the Lion plant in the manufacture of ammonia, nitric acid and ammonium nitrate from air and natural gas. Dark pelleted catalysts are promoted nickel and promoted iron oxide catalysts, the former used to produce the hydrogen required and the latter to convert carbon monoxide to dioxide, and to catalyze the reaction between hydrogen and nitrogen to produce ammonia. White pellets are zinc oxide, used to remove sulfur from incoming natural gas. The metal gauze is platinum-rhodium alloy, which oxidizes ammonia to nitric acid in the presence of air at high temperature

Hydrogen From Methane

In the abstract sense, ammonia synthesis apparently is quite a simple operation involving the union of one part elemental nitrogen with three parts of hydrogen. But therein lies the difficulty: getting them to combine and stay that way. Nitrogen long has been called one of the "lazy" elements, since it tends to revert to the uncombined state at every opportunity, hence is a common constituent of explosives. Hydrogen on the other hand is highly reactive, which makes it much the more expensive to obtain commercially of the two raw materials.

Catalytic processes long have been the only means of synthesizing ammonia directly from its elements. One of the two main stumbling blocks to low costs is the difficulty of securing hydrogen in the high purity required. The other is the high pressure required for a reasonable conversion per pass, as much as 13,000 psi being specified in some synthesis, notably the Claude and Casale processes(1). The process at the Lion chemical plant, U. S. Fixed Nitrogen Research Laboratory method, uses 5000 psi by comparison.

The reform process, which produces relatively high purity hydrogen from methane at low cost, now has gone far to reduce processing costs. The Lion plant is one of the first in the U. S. to be constructed using this process and the first to be operated by an oil company.

As used at the Lion plant, the methane reform process goes according to the following equations:

$$CH_4 + H_2O \xrightarrow[\text{Ni Catalyst}]{725^\circ\text{ C., 2-3 psi}} CO + 3H_2 \quad \ldots\ldots (1)$$

$$CO + H_2O \xrightarrow[\text{Conditions as (1)}]{\text{Same}} CO_2 + H_2 \quad \ldots\ldots (2)$$

Methane reforming as shown by equa-

(1) "Nitrogen Fixation" The Condensed Chemical Dictionary, p. 468, Third Edition, Reinhold Pub. Corp. (1942).
Rogers, Allen (Ed.) Industrial Chemistry, p. 335-38, Fifth Edition, Van Nostrand Co. (1931).
Riegel, E. R., Industrial Chemistry, p. 120-22, Fifth Edition, Reinhold (1944).

tion (1) and (2) does not go to completion in the primary unit, hence the effluent is charged to a second catalyst case, containing a different form of metallic nickel catalyst, together with sufficient air to supply the nitrogen needed later. Atmospheric oxygen must be removed also; two reactions occur:

$$2H_2 + O_2 \longrightarrow 2H_2O \quad \ldots\ldots (3)$$

$$CH_4 + CO_2 \xrightarrow[\text{Ni Catalyst}]{1025^\circ\text{ C}} 2CO + 2H_2 \quad \ldots\ldots (4)$$

Steam then is added and the mixture charged to a converter, in which carbon monoxide is oxidized to the dioxide over an iron oxide catalyst to produce additional hyrogen.

$$CO + H_2O \xrightarrow[\text{Iron Oxide}]{500^\circ\text{ C}} CO_2 + H_2 \quad (5)$$

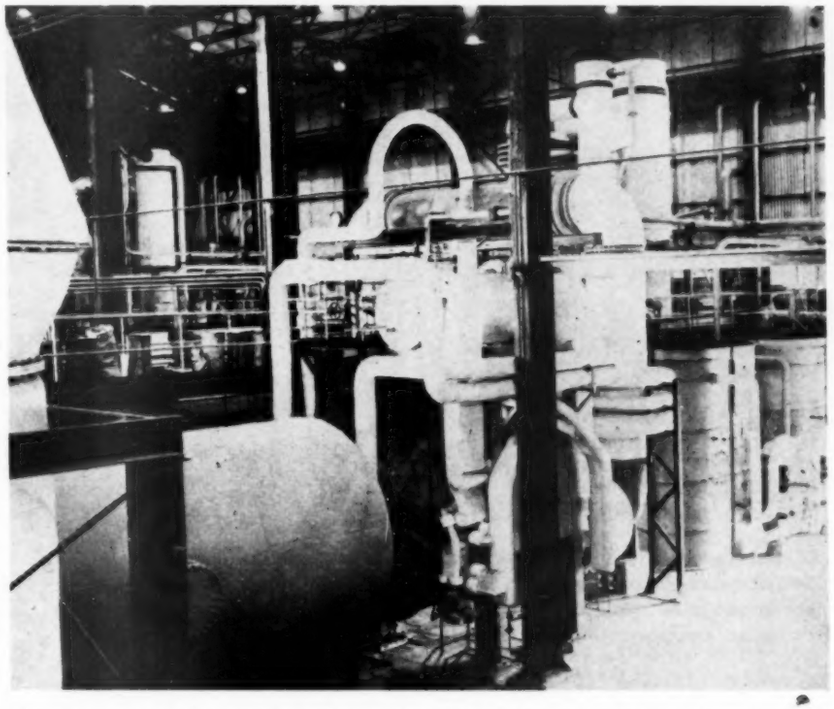
Methane Reform Group

In actual plant operations first thing which must be done is to remove all traces of sulfur from the incoming field gas having the composition shown in Table 1. Enough zinc oxide is carried in two organic sulfur removal vessels, operated in parallel on the primary gas stream, to last an estimated 15 years without replacement. The gas stream after passing through the sulfur removal vessels is practically free from organic sulfur compounds which would poison the nickle catalyst in the reform units.

In the following description of the processing, reference should be made to Fig. 1, which is a schematic flowsheet of the plant. The accompanying photographs of the various natural divisions of operations—Methane Reform, Ammonia Synthesis, and Ammonium Nitrate Plant—indicate physical size of equipment and complexity of some of the procedures to be described.

TABLE 1—Analysis of Raw Material Gas

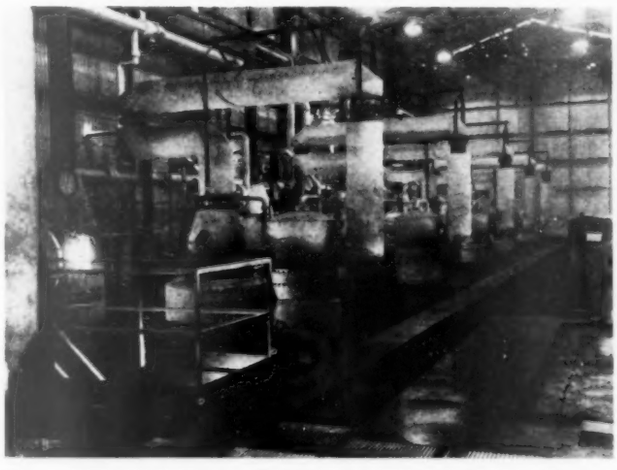
CO_2	1.6%
CH_4	92.9%
C_2H_6	4.6%
C_3H_8	1.4%
Butanes and Heavier	0.4%
Sulfur	0.5% ppm



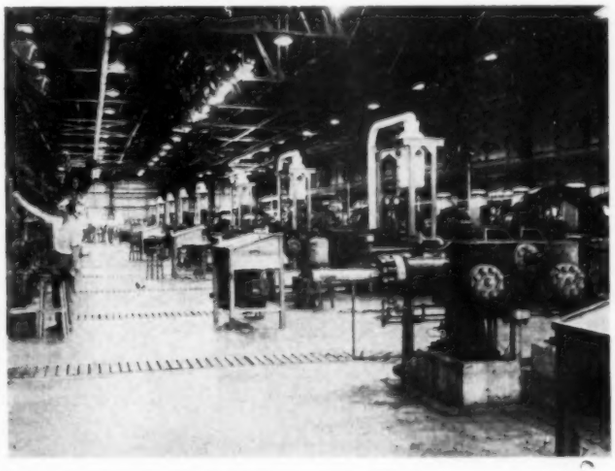
Massive size of the reform units in the Lion Chemical plant is shown in this photo. Center is the secondary reform unit, organic sulfur removal vessel to the right. Far left is waste heat boiler operating from flue gas, while passive piping overhead is the combustion air preheater

Gas from the field enters processing at 65 psi, passing through countercurrent exchange with hot reform gas before going to organic sulfur removal and thence to a steam-gas mixer. Steam, also at 65 psi, similarly picks up heat from effluent carbon monoxide converter gas before reaching the mixer. Charge to the primary reform unit enters at 400°C (752°F), 60 psi, with steam-to-gas ratio of 9.9 lbs per hour per cfm. Temperature in the reform furnace is approximately 1000°C (1832°F) fired with natural gas.

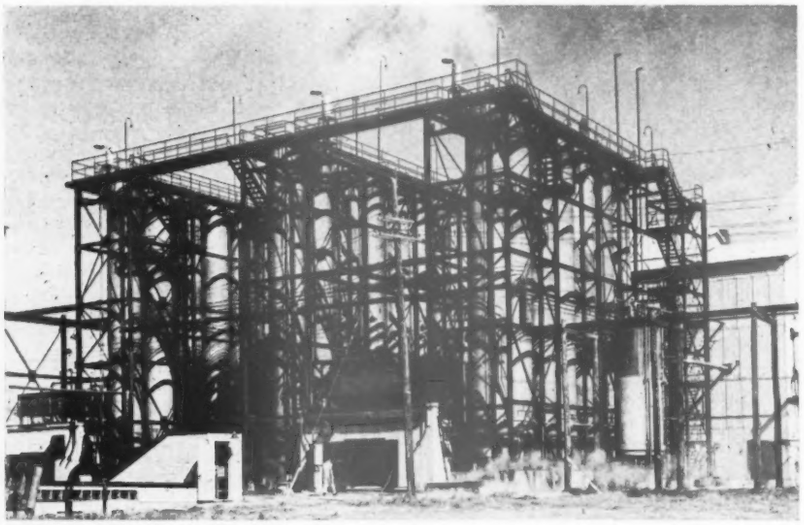
Reformed gas, having composition shown in first column of Table 2, leaves



Five units in the nitric acid building, each unit being made up of, left to right, burner and preheater, ammonia-air mixer and filter



Interior of ammonia synthesis building; left, control boards, right, 8 of 10 circulators recycling unreacted gases to the converters



Absorption towers where the nitric oxide is absorbed in water to form nitric acid. Here the gas is contacted with water increasingly stronger in acid until, in the last tower, only concentrated acid remains to catch the final traces of the gas and concentrated nitric acid is drawn off the bottom of the tower

the furnace at 5 in. Hg. pressure, 725°C, and steam-to-gas ratio of 1.5. The reform furnaces, of which there are four, each contain 66 6-in. catalyst tubes arranged in headers through which process gas passes. Catalyst, initially a nickel oxide supported on ceramic forms, is converted to metallic nickel upon activation. (Flue gases leaving the furnace at 950°C first are cooled to 375°C in a waste-heat boiler, then to 175°C by exchange with incoming combustion air.)

The secondary reformer also uses a ceramic-supported nickel catalyst. Primary reform gases, plus air, enter at 700°C but are raised to 1025°C (1877°F) by the reaction shown previously in equations (2) and (3). Composition of effluent is shown in the second column of Table 2. Since the carbon monoxide converter operates at a lower temperature than the secondary reformer, exit gases at 925°C are cooled to 700°C in a waste-heat boiler, further cooled to 500°C (932°F) with 20-lb. steam before entering the converter. Here the reaction shown in equation (5) takes place over a pelleted iron oxide catalyst. Leaving at 540°C with a steam-to-gas ratio of 3.0, the converted gas is exchanged with incoming process natural gas and steam and further cooled to 30°C by water before passing to the compression section. At this point, gas has the composition shown in the third column of Table 2. A conventional gasholder floats on the line to compression to take care of surges.

All equipment in the reform section is

TABLE 2—Analysis of Reform Gas*

	Leaving Reformer		Leaving CO	Charge to
	Primary	Secondary	Converter	Synthesis
H_2	75.3	56.9	60.0	74.1
N_2		21.0°°	20.0°°	24.4
CO_2	11.7	10.0	16.0	2 ppm
CO	11.2	10.9	3.0	15 ppm
CH_4	1.8	1.2	1.0	1.2
Argon				0.3

* In % except as noted. °° Includes approx. 0.25% argon.

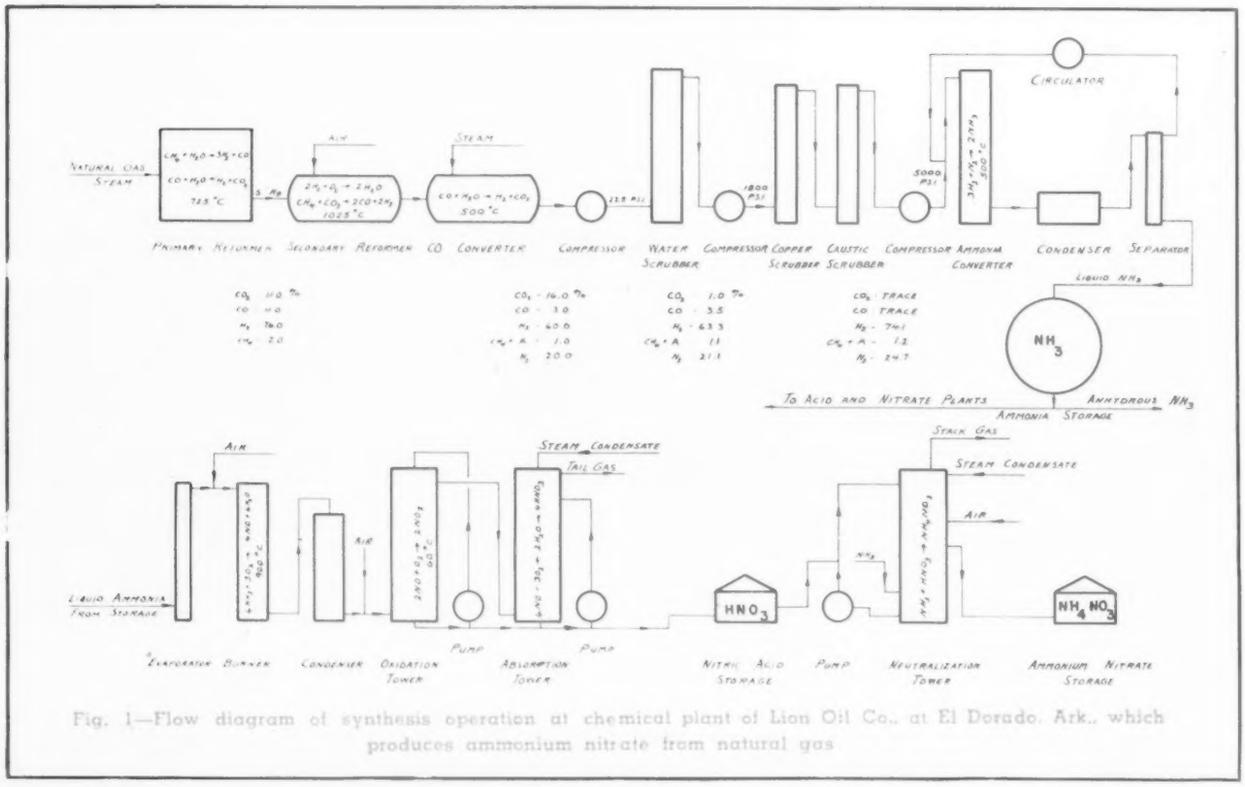


Fig. 1—Flow diagram of synthesis operation at chemical plant of Lion Oil Co., at El Dorado, Ark., which produces ammonium nitrate from natural gas

low-carbon steel, with the exception of the primary reform tubes which are stainless steel.

Ammonia Synthesis Group

Second natural division of the plant is known as the ammonia synthesis group, wherein the reaction:

$$3H_2 + N_2 \xrightarrow[\text{Promoted Iron Catalyst}]{500^\circ\text{ C, 5000 psi}} 2NH_3 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

is the principal occurrence although purification of reactants constitutes major portion of the equipment.

Cooled reform gas first goes through three stages of compression to 225 psi before going to water scrubbers where most of the carbon dioxide is removed. Scrubber water entering at 10-20°C is degased to release dissolved CO_2, cooled and recirculated. Effluent gas from the scrubber, still containing about 1% CO_2, is separated from entrained water and passes two more stages of compression before entering the copper liquor scrubber at 1800 psi.

Scrubbing solution consists of ammoniacal cuprous and cupric ammonium formates entering the tower at 0°C and leaving at 20°C. Gas passes counter-current to the solution, thence to a 5% caustic scrubber which reduces CO_2 content to 2 ppm or less, and finally a separator to prevent any caustic carryover. Following compression in a sixth stage to 5000 psi, where it has the composition shown in the last column of Table 2, synthesis gas is filtered to remove any particles of dust, rust and oil which would poison the synthesis catalyst. Here also it mixes with recycle gas from the ammonia converter.

Copper solution is continuously regenerated and cooled. Leaving the CO tower it exchanges with hot regenerated solution thence through a dual purpose tower, the top of which is a reflux section to reabsorb ammonia liberated in the lower part of the tower where CO and CO_2 are freed from solution and swept out in a carefully controlled air stream. System make-up is supplied in the reflux section also. Regenerated solution drops out of the tower at 75°C, is water-cooled and then further cooled by exchange with spent solution before passing successively to an ammonia cooler and the filter on its return to the CO scrubber.

Charge to the ammonia converter is continually purged to prevent build-up of methane and argon in the system. It is cooled to approximately −10°C in an ammonia cooled condenser to drop out as much ammonia (from the recycle gas) as possible, but still contains about 2% NH_3 from the recycle gas with which it was mixed.

Catalyst used is iron oxide, promoted with small amounts of potassium and aluminum oxides. Since temperatures much in excess of 600°C (1112°F) will ruin the catalyst and 500°C (922°F) ordinarily is used, it is essential that close temperature control be maintained at all times. Hence the incoming gases make two passes through the reaction section of the converter before contacting the catalyst in a system faintly resembling that used in a Houdry catalyst case. Provision also is made to by-pass the preheat system and charge cold gas direct to catalyst if over-heating becomes evident.

The catalyst chamber, some 20 ft. long, is constructed throughout of low-carbon steel in laminated fashion; built up to 6 in. wall thickness with ¼-in. sheets. Integrated with its bottom section is an exchanger, cooling effluent to 150° C. All piping in this section of the plant has a ⅝ in. wall thickness to withstand the normal working pressure of 5000 psi.

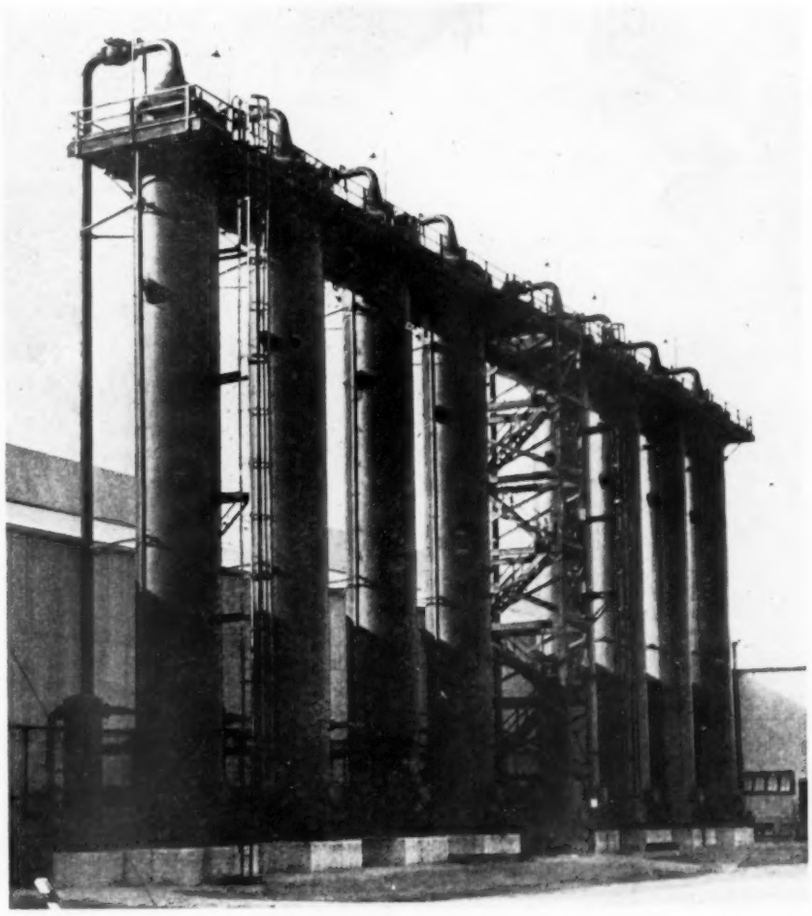
To give some idea of the compression required for the synthesis, all-told there are 24 1000-hp compressors required to furnish the six stages required. In addition, 33,000 horsepower is used for power generation, air compression, ammonia refrigeration and the like. In all, 54 gas-driven engines are located in one huge cross-shaped building. No outside power has been purchased since the plant first started operation. Only one power failure has occurred in this time, caused when a construction worker accidentally shortcircuited a line.

Converter effluent contains about 12.5% ammonia from the one-pass operation. It is cooled to 25°C in a primary condenser, liquid ammonia being trapped out in a separator. A steam-driven circulator picks up the "dry" gas at 4500 psi for recycling to the system at 5000 psi.

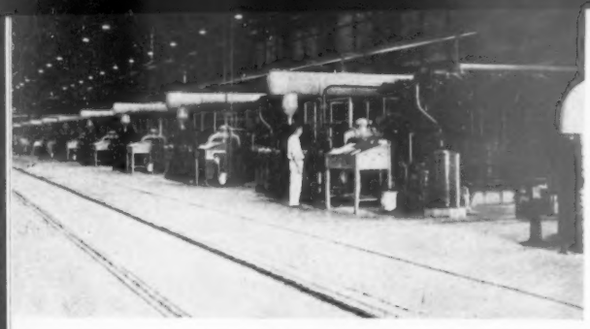
Liquid ammonia is carried through a scale-tank to spherical storage at 75 psi. Vapors from storage, containing largely ammonia but also small amounts of dissolved methane, argon, hydrogen and nitrogen, are continuously purged through an absorber. Aqueous ammonia, in about 20% concentration resulting from the absorption, is distilled and condensed to recover the ammonia. Absorber stack gases are vented to atmosphere. Since vented gases at ammonia storage or ahead of the ammonia converter contain less than 1% argon, it is not considered feasible to provide recovery equipment. Volume of hydrogen and nitrogen involved also is small at the storage point.

Nitric Acid Synthesis Group

The third and last natural division of the plant is the nitric acid synthesis group, sometimes known as the ammoni-



Water scrubbing towers, which scrub carbon dioxide from the gases coming from the converter before their synthesis into ammonia



View of one side of compressor building, said to be the largest compressor station under one roof in the U. S. It houses 60,000 h.p.

um nitrate plant. In essence, the operation consists of catalytic oxidation of part of the ammonia from the ammonia synthesis operation to nitric acid, then neutralizing the acid with an equivalent amount of ammonia to form an aqueous solution of 83% concentration.

The condensed equation expressing oxidation of ammonia to nitric acid may be written:

$$NH_3 + 2O_2 \longrightarrow HNO_3 + H_2O \quad (7)$$

Actually, the reaction takes place as follows:

$$4NH_3 + 5O_2 \xrightarrow[\text{Pt Gauze Catalyst}]{900^\circ\text{ C, 60 psi}} 4NO + 6H_2O \quad (8)$$

$$6NO + 3O_2 \longrightarrow 6NO_2 \quad (9)$$

$$6NO_2 + 2H_2O \longrightarrow 4HNO_3 + 2NO \quad (10)$$

Summation of equations (8), (9) and (10) gives:

$$4NH_3 + 8O_2 + 6NO + 6NO_2 + 2H_2O \longrightarrow 6NO + 6NO_2 + 4HNO_3 + 6H_2O \quad (11)$$

Simplifying equation (11) and dividing through by four gives the condensed equation (7) shown originally.

In processing, however, it is necessary to guard against occurrence of either of the following two reactions:

$$4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O \quad (12)$$

$$4NH_3 + 6NO \longrightarrow 5N_2 + 6H_2O \quad (13)$$

This is insured by using a very short contact with the catalyst and rapid cooling of the gases thereafter to prevent reduction. Temperature control also may be had by varying the ratio of oxygen to ammonia from the theoretical.

The final reaction, that producing ammonium nitrate, is simplest of all in theory and practice, involving a straight neutralization according to the equation:

$$HNO_3 + NH_3 \longrightarrow NH_4NO_3 \quad (14)$$

In plant operation, liquid ammonia is heated to 60°C under 60 psi pressure to vaporize it. Air is passed through the "burner" preheater where heat from the oxidation of ammonia preheats the air to 300° for partial temperature control of the reaction. Balance of temperature control is by varying ammonia concentration. Charge of ammonia and air enters the "burner" at 60 psi and 265°C (509°F), is heated to 900°C (1652°F) by natural heat of reaction as it passes through the catalyst mat composed of 80-mesh gauze of platinum alloyed with a small amount of rhodium.

Approximately 0.01 oz of platinum is lost per ton of equivalent 100% nitric acid produced, according to process engineers, when conversion efficiency ranges from 92 to 96%. There are about 90 oz. total of platinum and 10 oz. rhodium contained in the gauze used at each of the "burners."

Effluent gas from the burners at 795°C is cooled to 293°C in a waste-heat boiler and further condensed to 60°C in a condenser. Here some acid drops out, condensed in the water formed by the reaction. Secondary air, to oxidize nitric oxide to the dioxide (peroxide), mixes with the gas as it enters an oxidation tower where the reactions shown in equations (9) and (10) occur.

Six absorption towers back up the single oxidation tower in each of the three units, the major part of the content being recirculated to build up the concentration of acid. The recirculated fluid flowing down from above meets the upcoming stream of nitrogen oxides and air; tail gas containing small amounts of these oxides is vented.

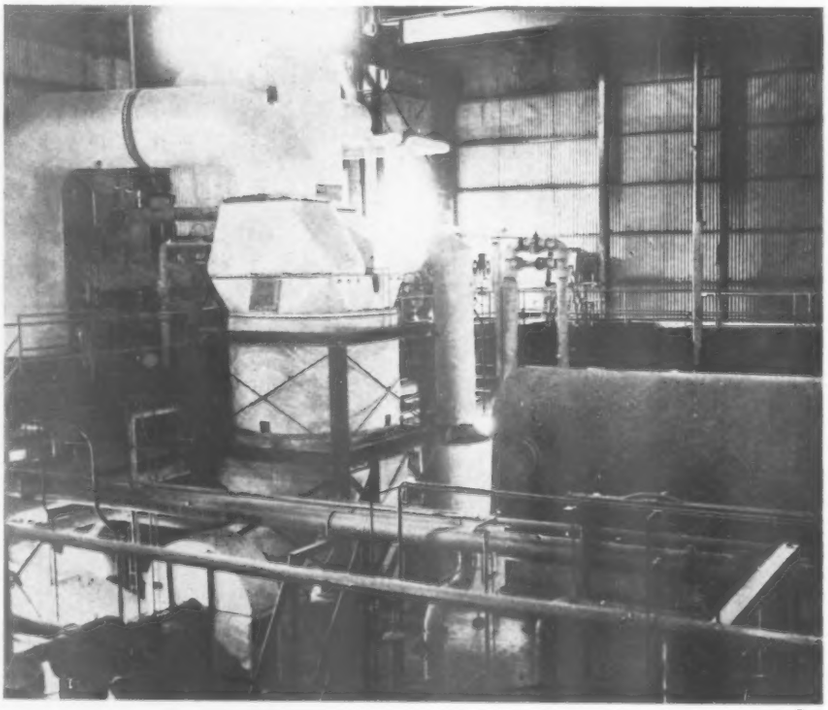
Acid from the strong acid absorber passes into a heater, then enters the top of a bleaching tank where undissolved oxides of nitrogen still remaining are swept out in a countercurrent air stream. Concentration of the now water-white nitric acid going to storage ranges as high as 60%, with 56% the general average. Purity is very high.

In the final operation, producing aqueous ammonium nitrate, all equipment comprising the two units, including piping, is stainless steel to guard against corrosion and to prevent discoloration and contamination of the final product.

The liquid ammonia is vaporized by steam in an evaporator, before entering the bottom of the neutralization tower at 40°C and 50 psi. Nitric acid for the neutralization is supplied from a constant-head tank, and enters the recirculating line through distributing nozzles.

The neutralization tower is packed with ceramic forms, provisions being made at approximately tower-center to take off ammonium nitrate solution and induct air for agitation and sweeping out any oxides of nitrogen freed during the reaction. Temperature at the top of the tower is held to 120°C (248°F), while at the bottom, 100°C (212°F) is carried. Liquid is continuously withdrawn from the bottom by a pump and returned overhead as reflux.

One of two final neutralization tanks for each unit next receives the solution. Here at a temperature of 75°C (167°F) the product is standardized to an 83% solution. It is adjusted to slight alkalinity for improved stability, and color is water-white. Two final neutralization tanks are employed so that one is pumping out to storage while final product is being standardized in the other. Laboratory tests are made right at the tank by the operator for control.



Small portion of a methane reform unit, size of which can be estimated from height of walkway railing in right center. At left is the combustion air preheater and, right, the secondary reform unit

TOMORROW in Petroleum Technology

A Preview of Coming Technological and Economic Developments, Based on Study of Current News on Petroleum-Related Topics in Various Fields

Today's happenings in widely-divergent fields are destined to have vital significance in the future operations of the petroleum industry. Technical and economic topics projected this month for their possible later bearing on petroleum refining operations include:

Antifreeze shortage in prospect.

Alcohol from petroleum faces interesting future.

Synthine detergents were developed by Germans.

Contemplated low-price cars may not be small.

Refiners face technically complex gasoline future.

Larviciding with oil sprays.

Antifreeze Shortage Appears in Prospect

Unless arrangements have been made by this time to operate the Morgantown Ordnance Works for the production of methanol, it appears likely that motorists may be faced with an acute shortage of antifreeze next winter.

This shortage has been occasioned by the disruption of ethyl alcohol manufacture caused by the scarcity of grains and blackstrap molasses. CPA officials have urged the Army to remedy the situation by operating several of its ammonia (Ordnance) plants for the production of methanol, but it has been learned that at least six months would be required to complete the necessary conversion, so that the methanol produced would not be available for the coming winter.

Late in the war, however, the now-closed, du Pont-operated Morgantown ammonia plant was being operated for methanol production, and this largest-of-all ammonia plants, it is hoped, can be put back into near-capacity production if some temporary arrangement can be made "for the transfer of that works from the Ordnance reserve to regular commercial use."(1)

Only rather conflicting statistics are at hand on the capacity of this plant, but one source reports that it had a daily capacity of 340 tons of ammonia and was also equipped to produce, per day, 90,000 gallons of methanol, 130,000 pounds of formaldehyde, and 100,000 pounds of hexamine. The last two are methanol derivatives, so that their methanol equivalent is *presumably* not additive to the methanol figure, but even 90,000 gallons per day amounts only to 16,000,000 gallons in six months—and the impending shortage is said(1) to approximate 25,000,000-40,000,000 gallons of methanol. American motorists appear to be in for a hard winter, with possible repercussions in the consumption of gasoline.

Alcohol from Petroleum Faces Future Problems

This same source(1) calls attention to the fact that "molasses processing for greater sugar recovery is contemplated on a large scale in all the sugar islands of the West Indies. Washington hears that several big contracts for new installations for juice or sirup purification by ion-exchange resins have been closed lately. This means that the return of (blackstrap) molasses to the fermentation industries of the U. S. grows less and less likely."

As the vice president of one of the first companies to produce alcohols from petroleum puts it,(2) "both the producers and consumers of ethyl alcohol are struggling with the dilemma of increasing markets and declining production."

Until recently, fermentation alcohol producers had been "getting 60% of their alcohol from grain and molasses and had purchased the other 40% from the RFC stockpile." The latter, reduced to less than 80,000,000 gallons, is now being used as a source for raw material for the recently-reopened alcohol butadiene plant at Institute, W. Va., and the grain situation guarantees that the alcohol "shortage will grow more acute with the stress placed on new production."

"Whereas 25 years ago all ethyl alcohol was made from grain and molasses, today virtually three-quarters of the existing production is being supplied by synthetic plants." Alcohol from these plants has never sold for more than 26.5 cents per gallon, compared to a range of 17-53 cents for fermentation alcohol (and much higher during the war), and the availability of this material at a steady price has encouraged its use for the production of numerous other chemicals.

"As a result of these developments, it is estimated that during 1946 and 1947 the alcohol equivalent of acetic anhydride going into cellulose acetate alone will amount to 50,000,000 gallons of ethyl alcohol per year, which is one half of the largest quantity ever produced by the fermentation industry in peacetime. The fact that there still is a substantial quantity of alcohol produced from fermentation, in spite of a high price, indicates that demand for ethyl alcohol has not reached a saturation point."

If the world food shortage continues for a few years, it seems inevitable that the production of fermentation ethyl alcohol will continue to decline, making it necessary: (1) to produce more synthetic alcohol, (2) to prepare in other ways those chemicals which are now based on ethyl alcohol, or (3) to substitute other alcohols in the solvent uses of ethyl alcohol. The last two alternatives are quite possible—acetic anhydride, for example, can be produced from acetone (from propylene), by oxidation of hydrocarbons, or from acetylene, and many of the other chemical derivatives can be produced directly from ethylene or other hydrocarbons. Similarly, isopropyl alcohol and methanol can be substituted in many of ethyl alcohol's solvent applications.

For these and other reasons, Parks takes a quite conservative view on the economic advisability of building more plants to produce ethyl alcohol from petroleum. He mentions that the *eventual* abundance of food will redivert molasses supplies from their present use as cattle feed, where

(1) Anon., *Chem. & Met. Eng.* 53, No. 5, 98 (1946), "Watching Washington."

(2) Parks, J. G., *Chem. & Met. Eng.* 53, No. 9, 116 (1946), "Solvents Face Difficult Expansion Problems."

they command higher prices, and that present building costs make it necessary for the potential synthetic alcohol producer to consider whether or not plants built today would prove good investments. Doubtful profits under OPA ceilings and the possibility of strikes and slow delivery of materials, delaying completion until new plants would be "too late to be of service in alleviating the present critical shortage," are also listed by Parks as reasons why "it is doubtful whether there will be a great expansion of synthetic plants except under special circumstances."

One factor not mentioned is the possibly-economic competition of alcohol produced from wood wastes and by-products, although this is by no means certain to eventuate. However, it seems possible that future prospects for synthetic alcohol are not as dark as this picture seems to paint it. As mentioned earlier in this section,[1] it is not at all certain that blackstrap molasses supplies will ever again be abundant, and it is equally doubtful that their price will ever again be as low as prewar levels. Cuban use for power alcohol production may also continue to be an important market factor.

Building costs are undoubtedly high, OPA ceilings certainly limit (and sometimes eliminate) present profits, and unsettled labor and material conditions may delay plant completions, but all of these arguments may be used to discourage construction of any kind. Also, the considerable application of catalytic cracking processes guarantees that many petroleum refiners will have large quantities of ethylene in their refinery gases and that they will certainly consider ethyl alcohol among the chemicals which might be worth producing from it rather than burn this versatile olefin as fuel.

Alcohol economics are exceedingly complex, and Parks is undoubtedly wise in calling attention to the fact that profits from the production of synthetic alcohol in new plants are not assured under the present circumstances, but it seems not at all unlikely that at least a few new plants for synthetic alcohol production will be constructed in the next few years.

Synthine Detergents Developed by Germans

The flood of reports on German data from the Office of the Publication Board contains information on many topics of interest to the petroleum industry, so it is only natural that some interesting facts have been revealed on the production of synthetic detergents from Synthine primary products. This is particularly true because "the serious shortage of fats and oils (in Germany) completely stopped ordinary soap production. This gave rise to tremendous developments in the field of synthetic detergents, emulsifiers, and wetting agents."[3]

Lindley[3] reports that peak production of the active ingredients of synthetic detergents and emulsifiers reached about 150,000 tons per year, "almost twice our highest war production." About half of this production was accounted for by the Mersols, produced from Mepasin, a C_{12} $-C_{14}$ hydrocarbon cut prepared by hydrogenating the 240-320° C. fraction of Synthine primary products. This cut was in turn reacted with sulfur dioxide and chlorine and the product sent to soap makers for saponification.

According to Lindley, the resulting detergent was "of decidedly inferior quality," although "a later product called Mersolat H, made by a somewhat modified process, was considerably better."

Some excellent detergents, the Igepons, were produced (in some cases) from oleyl chloride by condensation with the sodium salt of hydroxyethanesulfonic acid or that of methyltaurine; the oleyl chloride itself was produced from the synthetic oleic acid prepared by the oxidation of Synthine paraffin wax.

Other German detergents, such as the Igepals, made use of fatty alcohols produced from Synthine olefins by the "OXO" process. By varying the length of the oxyethane group produced by condensation of these alcohols with ethylene oxide, detergents for specific purposes could be produced.

Among the most important of the emulsifiers were the Emulphors, two of which were the cyclohexylamine salt of a Mepasin sulfonic acid derivative and the sodium salt of Mepasin sulfamidoacetic acid. "These were such excellent cutting oils for metal processing and as drawing compounds that their use was almost entirely restricted to these important war needs. They were quite outstanding for this purpose because they were emulsifiers which had great metal affinity and because they contained a rust-preventing polar group."

Space does not permit further details of these developments, but reference to these can be made, if desired, in *Publication Board Reports* no. 6, 17, and 187, among others. Many of these reports also refer to the production of fatty acids by the oxidation of Synthine wax, as mentioned; from these acids, the Germans produced vast quantities of soaps and edible oils.

It is significant to note, in the midst of so many "nothing very new" reports on German technology, that Lindley states that "it is my observation that the German advances in the detergent, emulsifier, and wetting agent field were quite outstanding."

Coming Low-Price Cars May Not Be Small

Although the public has become accustomed to associate low price and gasoline economy with the various "midget" cars which have appeared in recent years, it seems likely that the low-priced, light-weight automobiles planned for production next year by Ford, Chevrolet, and others will be full-sized cars.

According to one source[4] "the light cars contemplated by at least two and perhaps three leading manufacturers will not be small packages such as have been talked about in certain circles during recent years. They will be, instead, what may correctly be called full size cars—lighter, with shorter wheelbase and smaller engines—designed to sell under the lowest price models offered now by the same manufacturers." As still another source[5] has put it, "this time the battle will be over the so-called 'light car'—a misnomer because the real goal is not light weight but low price."

Both Ford and Chevrolet have created divisions to complete designs of cars which will sell for less than $1000, a price class which has always held the volume automobile market. "Detroit accepts it as a self-evident proposition that sooner or later Plymouth, Studebaker, Nash, newcomer Kaiser-Frazer, and other builders of popularly-priced cars will be shooting at the same objective."[5]

It is more than interesting to note that both Ford and Chevrolet have broken with past tradition and have decided to tool from the ground up rather than to produce stripped-down versions of their higher-priced cars. Each company is planning to spend about $50,000,000 for production facilities.

In regard to other automobile developments, it now seems certain that few automobile companies other than Studebaker will shut down for a model change-over this year. New Studebakers, incidentally, will use 5.50 x 15 in. tires instead of the 6.00 x 16 in. tires in general use on Fords, Chevrolets, and Plymouths. "An advantage of the smaller tire, besides cost, is that it lowers the car's profile by an inch from road to axle."[5]

It has also been noted that, "al-

(3) Murray, R. L., *Chemical Industries* 58, No. 5, 788 (1946), "ACS Hears Evaluation of German Developments."

(4) Geschelin, J., *Automotive and Aviation Industries* 94, No. 7, 44 (1946), "Observations—Small Cars."

(5) Anon., *Business Week*, No. 868, 15 (1946), "Drive is On For Low-Price Car."

though the only automatic transmission offered in 1946 is still the Hydra-Matic, the (automobile) industry is apparently closer to its widespread use than ever before *** in view of the amount of work now in progress which is bound to be translated into production units before long."[4] All of these developments are highly pertinent to the petroleum industry, which must keep abreast of automotive advances in order to provide proper fuels and lubricants and plan future operations in accordance with prospective demands.

Refiners Face Technically Complex Gasoline Future

This last statement was strongly emphasized in a recent paper[6] by Earl Bartholomew of the Ethyl Corp. Many of the basic details of this paper have already appeared in NATIONAL PETROLEUM NEWS[6], but two paragraphs from the paper serve concisely to summarize the conclusions:

"It is apparent . . . that the designer of engines for the new fuels must reckon with more than Motor and Research Method octane numbers. He must necessarily understand the potentialities of the different types of fuels in respect to compression, volumetric efficiency, and speed; also have knowledge of the volume in which the different types of fuel are likely to be produced. There will be no satisfactory substitute for actual tests of representative fuels in experimental engines during the development stage.

"Likewise, the fuel refiner should understand these engine-fuel relationships in order that he may, to the extent economically feasible, adjust fuel composition to the trends of engine design dictated by transportation requirements. The problem calls for the closest possible cooperation between the technologists of the oil and automotive industries."

This theme was also emphasized in a recent declaration[7] by D. P. Barnard of the Standard Oil Co. (Indiana), who listed automatic clutches and transmissions as devices most likely to demand careful tailoring of gasolines. Strict control of volatility will be required, "since automatic clutches depend upon perfect idling characteristics," but these devices "will also permit higher compression ratios for fuels of given octane numbers. Another new device affecting volatility requirements will be the improved manifolds now being designed."

In regard to future octane number levels, it is interesting to note that Bartholomew[6] believes that premium and regular-grade gasolines in 1950 will have A.S.T.M. Motor Method octane numbers of 86 and 80, respectively, with Research Motor Method ratings of 93.5 and 86.0. It is certainly not improbable that such ratings can be realized—Bartholomew points out that certain companies were already exceeding them in February, 1946—but the next few years will impose competitive hardships on those companies not so fortunate as to have erected catalytic cracking plants during the war.

If one could be a disinterested bystander, it would seem almost humorous to watch the octane number struggle between catalytic cracking and tetraethyl lead interests, on the one hand, and the refiner who has been "backward" in installing high-octane gasoline equipment, on the other. Meanwhile, the automotive industry has come to realize that, whether it wants them or not, high octane gasolines will shortly be generally available, also that the public, which has long been overly octane-conscious, will expect superior performance from new cars containing engines which will have to be designed to use them.

No matter who else loses, it will not be the public—another evidence of the advantage of free, competitive enterprise over controlled industry. Few bureaucracies would willingly permit soundly-engineered plants to become obsolete before their time, to see dies and tools cast into the scrap heap before they are outworn. It is to be hoped that the petroleum industry will present this and other evidence to refute those specious claims that it is a monopoly-dominated field.

Larviciding With Oil Sprays

One of the items discussed last year[8] dealt with a recent patent on pest control which called for the use of oils heavier than water instead of the more generally used types which are applied to the surface of stagnant water bodies to form oil films, "leading to the killing of the insect while in the larval stage."

While this new development is not mentioned, possibly because it has not been widely accepted at least as yet, it is interesting to note in a recent booklet on *Larviciding*[9] that, while "oil larvicides are several times more costly than paris green" where malaria control programs are concerned only with *Anopheles* mosquitoes, diesel oil or (No. 2) fuel oil is effective in killing almost all kinds (species) of mosquito larvae, as well as very young larvae and pupae."

According to this booklet, kerosine is seldom used alone to control *Anopheles* larvae, because of its high cost, although it is sometimes used on small ponds or pools, alone or mixed with waste motor oil. "Contrary to popular belief, waste motor (crankcase) oil alone is a very poor mosquito larvicide. It has low toxicity, does not spread well, and leaves a dirty, unsightly film on the water surface and on vegetation. It has limited usefulness in malaria control operations" and should generally be diluted with two or three parts of kerosine or diesel oil.

Petroleum oils, unlike paris green, kill larvae and pupae by contact instead of serving as stomach poisons. If the toxicity of the oil is satisfactory, an exposure of 1-10 minutes is sufficient.

Various emulsions containing oils are said to have proved highly satisfactory. One containing pyrethrum extract, kerosine, water, and an emulsifier, diluted with 1-10 parts with water before use, found only limited use during the war because of the shortage of pyrethrum, but an oil-water emulsion formed by adding an emulsifier to diesel oil or kerosine, then diluting and agitating with water before spraying, yields a spray which "results in a dual saving of oil and transportation." However, it is said that "this larvicide has not had wide enough use to permit conclusions as to its applicability as an anopheline larvicide."

It would seem that the use of paris green dusting offers formidable competition, since the statement is made that such dusting 'is never more expensive than oil larviciding." The booklet lists five advantages for paris green: "(1) Most economical larvicide. Lowest overall cost. Saves materials, equipment, manpower, and transportation. (2) Most effective larvicide where horizontal or submerged vegetation is dense. (3) Can reach breeding places not accessible to oil. (4) Less fatiguing to labor. (5) Avoids oil burns from leaky knapsack sprayers, etc."

On the other hand, diesel oil larvicide is: (1) More effective than paris green in clean or relatively clean breeding places. (2) Can be applied less frequently than paris green. (3) Under some conditions, prevents egg laying by female mosquitos. (4) Avoids burns in folds of skin peculiar to paris green and lime. (5) Labor can be trained more easily, and inspection of spraying work is easier. (6) Less affected by weather.

(6) Bartholomew, E., *Potentialities of the New Fuels in the Design of Passenger Car Engines*, S.A.E. Summer Meeting. June 2-7, 1946; NATIONAL PETROLEUM NEWS 38, No. 23, 19 (1946).

(7) Anon., NATIONAL PETROLEUM NEWS 38, No. 21, 44 (1946), "Sees New Auto Engine Designs."

(8) Anon., NATIONAL PETROLEUM NEWS, *Technical Section* 37, No. 27 R-538 (1945), "Keeping Up With the News—Pest Control."

(9) Anon., *Larviciding*, Federal Security Agency, U. S. Public Health Service (Atlanta), October, 1945.

New Method for Removing Salt from Crude Uses Fibrous Glass, Requires No Chemicals

Effective desalting of crude petroleum to less than 5 lbs. of salt per 1000 bbls. of crude is claimed for a newly developed method using beds of fibrous glass. The method involves combining the crude charge with a measured amount of wash water, and then passing the mixture, with temperature controlled between 250 and 350° F., through a contactor containing beds of fibrous glass packing. The small glass fibers (0.00028-in. diameter) cause the emulsion of salt water and oil to break so that the brine forms into droplets which can be drawn off in a settler. No chemicals, other than to control pH of the wash water, are required.

Although no commercial installation has yet been made, the cost of the process is said to be attractive for such applications.

AN EFFECTIVE method of desalting crude to less than 5 lbs. per 1000 bbls. by contacting with fibrous glass packing was recently presented as "Desalting of Petroleum with Fiberglas Packing" by T. A. Burtis (now with Owens-Corning Fiberglas Corp.) and C. G. Kirkbride, A. & M. College of Texas, before the American Institute of Chemical Engineers. The method requires no chemicals except for pH control to avoid vessel corrosion and packing deterioration. Pilot plant investigation indicated procedure costs less than 0.3c per bbl. of crude to operate, and equipment investment (10,000 b/d unit) is approximately $3.70 per bbl. Method is not yet in commercial use and patent licenses are royalty-free.

Essentially, the procedure is an adaptation of earlier processes for resolving emulsions in which the crude contacted various media, including fullers' earth, clay, magnesium silicate, silica gel, sand, excelsior and glass wool. The earlier methods assertedly gave erratic results and extent of desalting varied considerably with the type of oil processed. However, in the Burtis-Kirkbride method the variables which affect the performance of the packing—superficial velocity of oil through contactor, temperature, bed depth, density of packing in beds, salt concentration in recycle water, pH of recycle water and pressure drop through beds—are closely controlled.

Following paragraphs are a condensation of the paper.

Equipment and Procedure

Fig. 1 illustrates the disposition of pilot plant equipment and flows. Crude charge is combined with a measured amount of wash-water before entering the suction side of the gear-type pump. The water, which acts as a diluent for the strong brine emulsified in the crude and a solvent for any crystallized salt present, is thoroughly mixed with the oil during pumping without formation of a highly-stable emulsion. The mixture then is passed through a heat-exchanger or heater before entering the contactor.

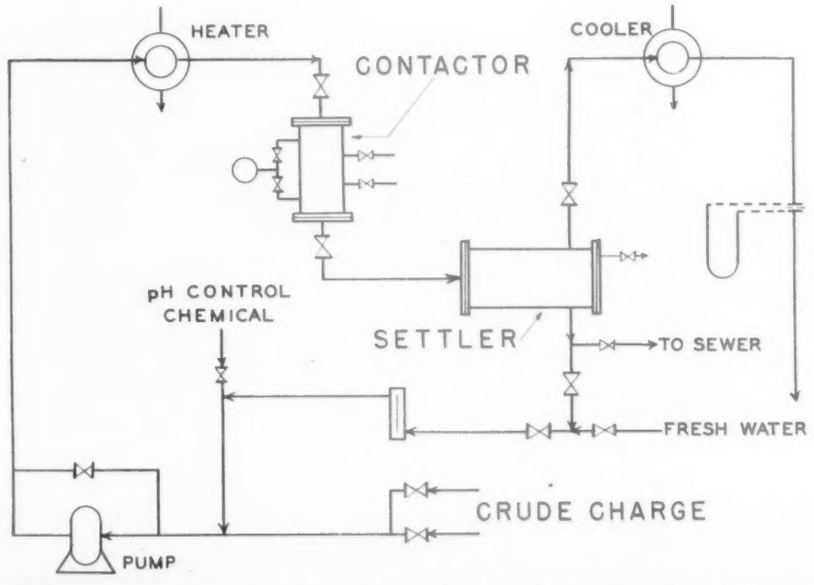


Fig. 1—Flow diagram of pilot plant for desalting crude with Fiberglas glass fibers

The contactor contains three beds of No. 28 Basic Fiberglas packing, (averaging 0.00028-in. diameter and containing 1079 sq ft. of surface per lb.) 2 in. thick, with a minimum total bed depth of 5 in. Here the emulsion is broken by the fibers and the brine forms into droplets large enough to separate from the continuous oil phase, which occurs in the settler. Oil is withdrawn from the top of the settler through a cooler to storage. Brine from the bottom is returned to process with make-up fresh water equivalent in quantity to that bled off for control of salt concentration in the brine.

Recycled wash-water pH was maintained between 7 and 8. Actually, it was seldom necessary to adjust this pH in the pilot plant because the amount of brine being removed from the crude was small in comparison with the total water content of the system and only a very small change in the pH took place during relatively short runs. However, a high pH (strong alkalinity) is considered detrimental to the glass packing and a value much below 7 would render the water corrosive to the steel in a commercial unit.

Two different externally insulated contactors were used. One was constructed of 4-in. Schedule 40 steel pipe, 18 in. long. Blind flanges, drilled and tapped for ½-in. nipples, were installed on each end; pressure taps were located 1 in. from each end of the vessel for determination of pressure drop, and sampling connections were provided between the first and second beds. The beds were supported by perforated 1/16-in. steel plates attached to the vessel wall.

The other contactor was of 2½-in. Schedule 40 pipe, 18 in. long. Otherwise it differed from the first contactor design only in that bed-spacers were provided so that more than one bed could be used. Thus only the bottom bed was supported.

The settler consisted of 26 in. of 8-in. diameter Schedule 40 pipe, insulated and blind-flanged. One flange was tapped for a ½-in. nipple through which charge was admitted; the other was tapped for a ⅜-in. nipple through which samples could be withdrawn at intermediate points in the settler. Desalted oil was withdrawn 18 in. from the inlet through a half-inch line, while wash-water withdrawal was through ⅜-in. line, also 18 in. from the inlet.

Baffles of 16-ga. sheet iron 14 in. long, spaced 1 in. apart and inclined 20°

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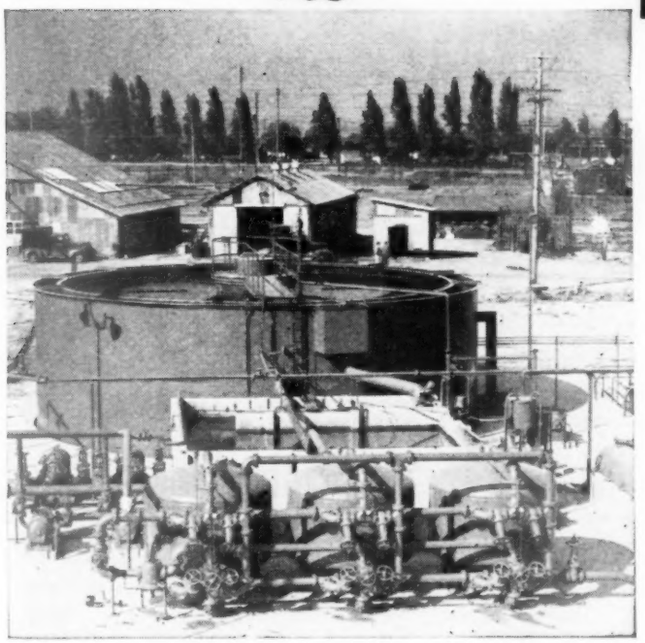
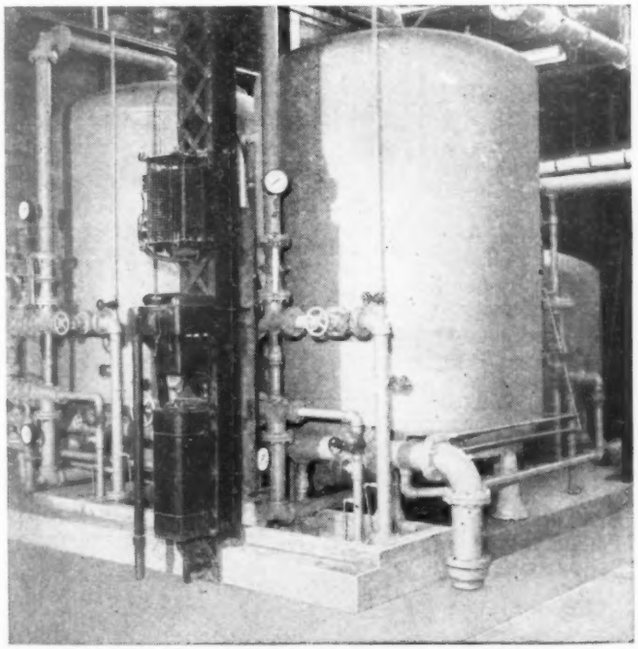


Graver Reactivator and Graver Zeolite Softener installed for a major oil company

Top: Graver Reactivator *Bottom: Graver Zeolite Softeners*



BOILERFEED make-up water when taken from deep wells or other clear water sources may not require pretreatment before softening. Whereas, turbid water from rivers or impounded surface supplies must be pretreated or pre-settled prior to the softening process. This pretreatment should remove most of the suspended solids contained in these turbid waters, and—in the interests of efficiency—should be carried out in a single tank in a minimum of time.

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TABLE 1—Characteristics of Crudes for Desalting*

Crude	Gravity, ° API	Average Salt lbs/1000 bbls	Viscosity SSU
Hastings	31.3	65	50 @ 100 F
Panhandle	33.4	50	.....
West Texas	34.4	29	45.2 @ 128 F
S. Louisiana	34.3	122	41.2 @ 128 F
W. Texas	29.2	272	39.6 @ 128 F

* Figures are averages for each 12-bbl sample of oil.

from the horizontal in the direction of flow were inserted as a bundle, providing a free-space at the outlet end of the settler. Clearance of ¼-in. between baffles and vessel was provided. Interface level customarily was maintained manually at the lower third of the vessel diameter.

Five crudes were desalted under differing conditions during the investigation. Average salt contents, gravity and viscosity appear in Table 1. Glass fibers were packed to a density of 4.95 lbs. per cu. ft. as received, although the glass itself has a density of 159 lbs. per cu. ft. Even at as-packed densities as high as 15 lbs. per cu. ft., the apparent limit from practical considerations, the beds contained over 90% void space.

Most of the runs were made with three individually-supported beds in the 4-in. contactor. Packing usually was 5 in. in total depth and 13 lbs. per cu. ft. in density but varied in several of the runs. Runs also were made with the 2½-in. contactor, which also had three beds of 13 lbs. per cu. ft. density, packing totaling 5-in. depth.

Three types of analysis were required in the experimental work: determination of salt content in the oil, of salt in the water, and of the pH of water. Salt content of the oil, reported as NaCl, was determined as chloride ion after demulsifying with 0.4 xylol destabilizer, washing with water, settling and titrating the water phase colorimetrically with 0.02 normal silver nitrate in the presence of potassium chromate. The same titration was used for wash-water salt estimation. Determination of pH was made by color comparator, although in early work this was checked electrometrically.

Samples of raw and desalted crude were secured in all runs for analysis as quickly as possible, duplicate runs by two methods of drawing sample assuring that no adsorption of salt was occurring on the wall of the sampling vessel. Oil samples also were taken hot from between contactor beds by displacement of hot brine from a sample bomb; sample was allowed to stand for a period equal to residence time of oil in the settler before decantation and analysis. Settler oil was sampled at points corresponding to different residence times, while wash-water samples were withdrawn from the recycle line at the bottom of the settler.

Theory of Demulsification

Demulsification by solid contact apparently is effected by coalescing the minute water droplets due to rupture of protecting films when the emulsion flows through small passages, with coalescence of the droplets due to preferential wetting of the contact solid by the aqueous phase. Hence any contact solid used for demulsification should have a large surface and a strong affinity for water. The more important variables which affect the performance of fibrous glass as a desalting medium are (1) superficial velocity of the oil through the contactor, (2) temperature of the oil during contacting, (3) water-to-oil ratio, (4) total depth and density of beds, (5) recycle water salt content, (6) pressure drop through each bed and (7) pH of the recycle water.

Superficial velocity as used in this work is defined as the linear velocity, in feet per minute, with which the oil *only* would pass through the empty contactor. Figs. 2 and 3 show the effect of this variable.

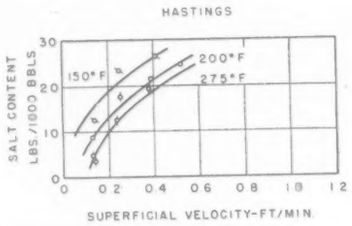


Fig. 2—Effect of velocity and temperature at 0.1/1 water-to-oil ratio on desalting

Effect of Velocity

Fig. 2 is a correlation of data taken on Hastings crude with water-to-oil ratio arbitrarily fixed at 0.1/1, and temperatures of 150, 200 and 275° F. With contactor temperature at 275° F., effluent salt content increased from 4 lbs. per 1000 bbls. to 23 lbs. as velocity increased from 0.12 to 0.5 ft. per min. Similarly at 150° F. salt content increased from ten to 26.5 lbs. per 1000 bbls. as velocity increased from 0.05 to 0.4 ft. per min. Operating conditions for these runs were not the best, since it is shown later that water-to-oil ratio of 0.2/1 greatly facilitated desalting of this crude.

Other investigations on the effect of superficial velocity were made with Panhandle, Hockley Co. (West Texas) and West Texas (sour) crudes under more favorable conditions (Fig. 3).

Optimum superficial velocity is apparently dependent to some extent on the type of crude but perhaps to a greater extent on the water-to-oil ratio and temperature, particularly below the respective values of 0.1/1 and 200° F.

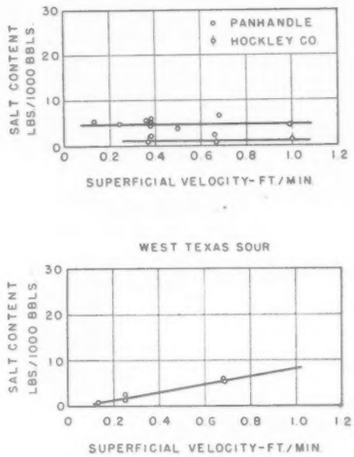


Fig. 3—Effect of superficial velocity on desalting at optimum water-to-oil ratios for three crudes

Effect of Temperature

The significance of temperature on desalting of Hastings and West Texas (sour) crudes is brought out in Fig. 4. Extent of desalting of Hastings crude increased gradually as temperature increased. The effect was much more pronounced with the West Texas crude. In the range 200-275° F. good desalting was obtained, maximum salt in the effluent reaching only 2 lbs. per 1000 bbls. However, when temperature dropped below 200° F., desalting became poor and reached 74.5 lbs. per 1000 bbls. at 150° F.—higher than the initial salt content of the oil. At the lower temperature the Fiberglas was incapable of

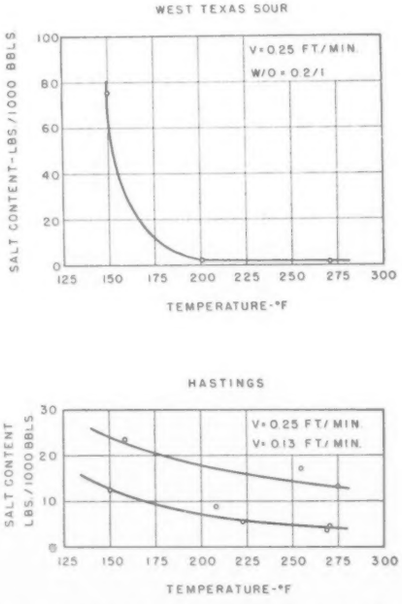
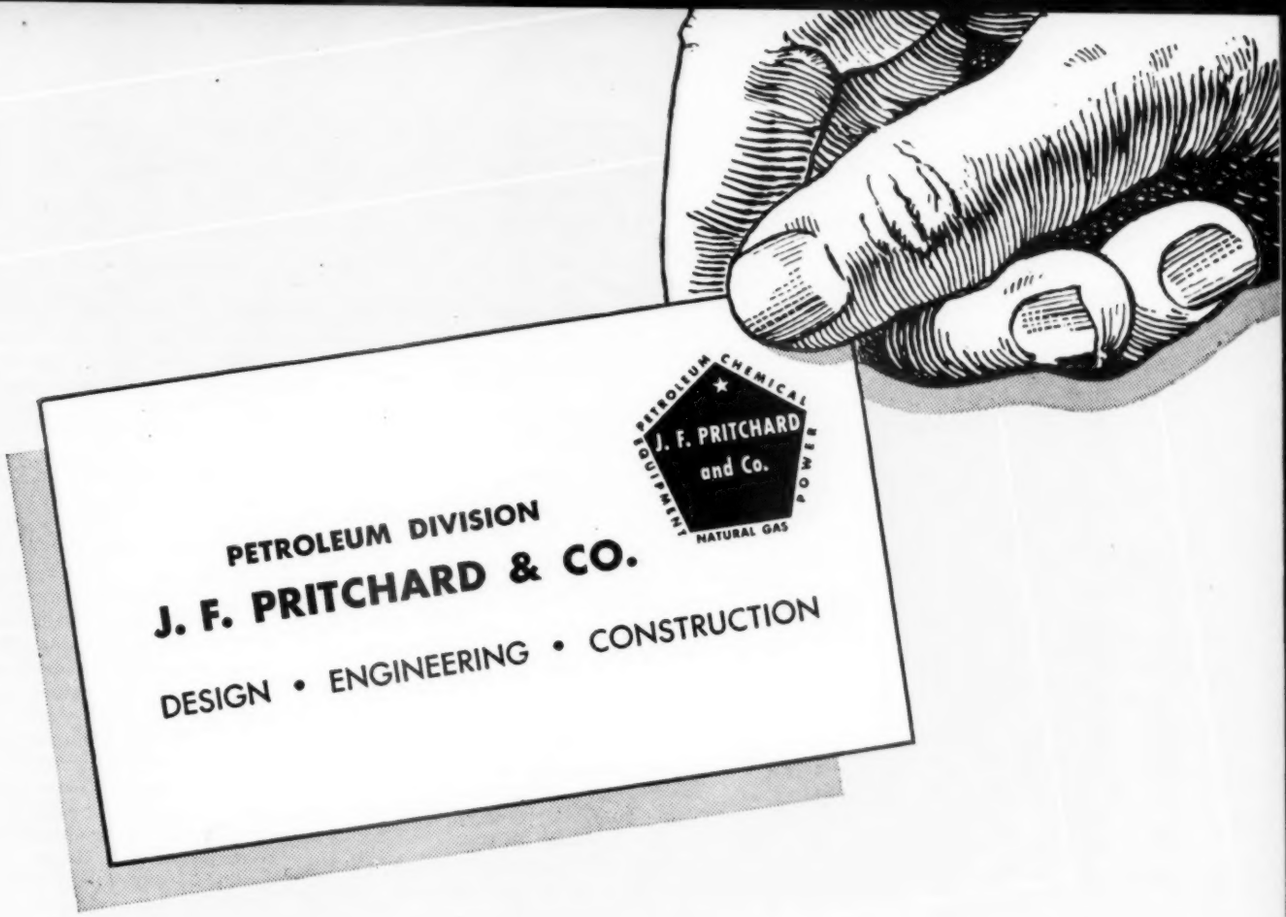


Fig. 4—Effect of temperature on desalting



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breaking the emulsion and settling was ineffective.

Best desalting appears to occur at temperatures above 250° F.

Water-to-Oil Ratio

The amount of brine present in even a high-salt crude is very small. For example, a crude oil which contains 200 lbs. of salt per 1000 bbls. corresponds to 577 lbs. of brine containing 35 wt.-% salt (chlorides expressed as NaCl). The volume of brine thus would be about 0.17% of the oil. Only 700 gal. of fresh water per 1000 bbls. of crude, or 1% by volume, would be required to dilute the brine to less than 3 wt.-% of salt—assuming complete contact between brine and fresh water is attained. In practice, unless water is recycled it is generally necessary to use a relatively large volume of fresh wash-water to attain thorough contact.

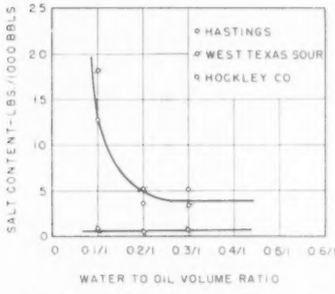


Fig. 5—Effect of water-to-oil ratio on desalting

Fig. 5 indicates that water-to-oil ratio should be at least 0.2/1 for most crudes to attain good desalting and there apparently is little gain in using ratios above 0.3/1. In the case of Hastings and West Texas (sour) crudes, the effect of water-to-oil ratio is sharp in the range of 0 to 0.2/1. In the case of the Hockley crude the effect is not great, but probably exists below the ratio of 0.1/1.

Wash Water Salt Content

The amount of fresh water required is a function of the salt content of the crude and of the water rejected to sewer. The required amount of make-up water then depends on the salt concentration permissible in the wash-water. Fig. 6 presents the effect of salt concentration in the wash water on the extent of desalting with two crudes. In both cases salt concentration in recycle water was varied while all other factors—superficial velocity, temperature and water-to-oil ratio—remained constant.

With South Louisiana crude the desalting was less effective in direct proportion to the increased salt concentration in the wash water over the range investigated. With West Texas (sour) crude, on the other hand, desalting at first was less and then more effective as wash-water salt content increased.

Results with Hockley crude were similar to those with South Louisiana crude. Good practice requires that the brine concentration should not exceed 3 wt.-% of salt. Besides providing good desalting, this has the added advantage of keeping salt deposition at a minimum in event poor operation should permit brine to be carried over into the effluent.

Bed Thickness and Density

Samples were taken between beds to determine the effect of bed thickness on desalting.

At a ratio of 0.1/1, salt content in the effluent declined from 65.1 to 30.1 lbs per 1000 bbls in the first 1⅞ in. of bed depth, dropping to 21.2 lbs. in the next 1⅝ in. and to 12.8 lbs. per 1000 bbls. in the final 1½ in. This is not a good test because it has previously been shown that ratio should be 0.2/1 or higher.

At a 0.2/1 water-to-oil ratio, salt content dropped from 65.1 to 4.2 lbs. per 1000 bbls. in the first bed with no subsequent change. From this it is concluded total bed depth of 3 to 4 in. is sufficient with a water-to-oil ratio of 0.2/1 or higher, while ratios higher than 0.3/1 have little benefit.

Practically all experimental work was done with a bed density of 13 lbs. per cu. ft. because this gave consistently good results and can be attained easily in commercial installations. However, a few runs were made at other densities to determine the effect of this factor.

As bed density increased from 9 to 15 lbs. per cu. ft., salt content of desalted oil decreased from 18.4 to 3.2 lbs. per 1000 bbls. Densities above this maximum are undesirable because of the high pressures required to obtain them and the probability that such pressures would tend to disintegrate the glass fibers during handling.

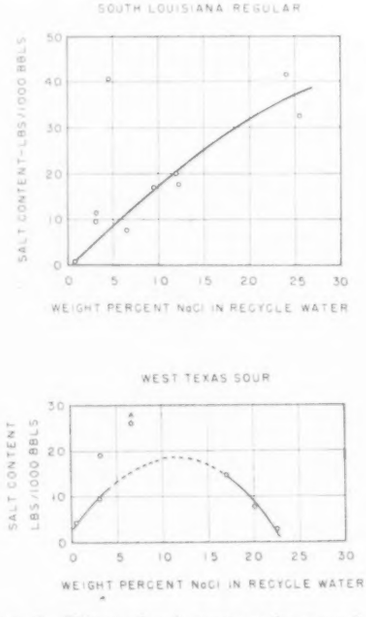

SOUTH LOUISIANA REGULAR
SALT CONTENT-LBS/1000 BBLS
WEIGHT PERCENT NaCl IN RECYCLE WATER
WEST TEXAS SOUR
SALT CONTENT LBS/1000 BBLS
WEIGHT PERCENT NaCl IN RECYCLE WATER

Fig. 6—Effect of salt content in recycled wash-water on desalted effluent with South Louisiana (upper curve) and West Texas (sour) crudes

Excessive Pressure Drop Undesirable

Pressure-drop through a single bed should not be permitted to exceed 40 psi. Excessive drop will crush the glass fiber beds and bring on immediate loss in efficiency. In a series of runs with the small contactor, which contained three beds not individually supported, the packing became plugged with silt from the West Texas crude. Since the projected superficial velocity at the time was 0.66 ft. per min., a pressure drop of 70 psi occurred with the plugging, resulting in considerable disintegration of the bottom bed when the entire pressure drop was transmitted directly to the bottom of the bottom bed. Subsequent runs with the larger contactor, containing individually-supported beds, permitted runs to continue with no further excessive pressure drop.

It is concluded that multiple, individually-supported beds are to be preferred, and that depth of each bed should not exceed 2 in. at 13 lbs. per cu. ft. density. Pressure-drop preferably should be maintained at less than 5 psi per inch of bed depth and superficial velocity limited accordingly.

The pH of wash water was demonstrated as having no effect on desalting in the range 5.3 to 8.9; run lengths were insufficient to demonstrate any effect of alkalinity on the Fiberglas.

Design of Commercial Units

A preliminary economic study was made for a commercial unit of 10,000 b/d capacity on basis of present data. It is estimated that an installation based on API-ASME Code requirements will cost $3.70 per bbl. capacity. Cost of operation has been estimated below in Table 2, assuming three individually-supported beds of No. 28 Basic Fiber Fiberglas 2-in. deep, 13 lbs. per cu. ft. density, temperature of 275° F., superficial velocity of 0.50 ft. per min., water-to-oil ratio of 0.2/1, maximum of 2.5% salt in brine, pressure drop across contactor of 30 psi and glass cost of $2 per lb.

TABLE 2—Estimate Operating Cost for 10,000 B/D Commercial Unit

Bed Life, Days	Cost, $/bbl Ex Amortization	Cost, $/bbl 5 yr. Amortization
60	0.00217	0.00411
90	0.00159	0.00353
180	0.00101	0.00295
365	0.00071	0.00265

The economic study was based on desalting at 28° API crude of 100 lbs. salt per 1000 bbls. Settler design was based on ten minutes residence time with 6-in. spacing between baffles. It was assumed the cost of power would be 1c per KWH, heat cost of 30c per million Btu and labor cost of $1.25 per man-hour. No royalty costs are involved since the process, although patented, is royalty-free.

PLANT PRACTICES

. . . for refinery Superintendents and Foremen

Practical Tips and Ideas Based on Actual Refinery Operating Experience

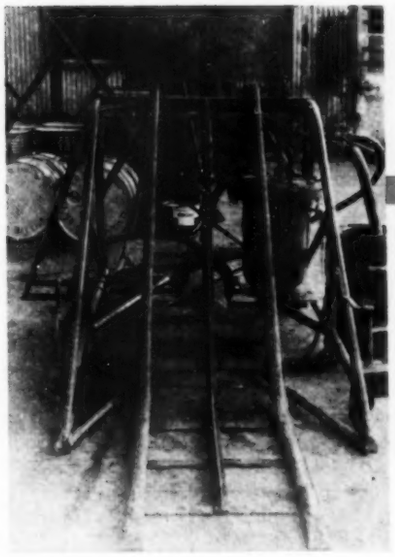
Hydraulic Drum Lifter Is Faster and Safer, Loads 2 Barrels onto Truck in Seconds

By BERNARD I. BELL—Houston Refinery, Sinclair Refining Co.

Worthwhile savings in manpower and time, together with improved safety conditions, resulted from the fabrication of the hydraulically operated drum lifter shown. Formerly, when 55-gal. drums of oil were to be loaded into trucks for shipment, they were rolled up an inclined ramp by hand, a slow method, inefficient in manpower utilization and potentially dangerous to the men. With the drum lifter in use, two drums can be hoisted and rolled onto the truck bed in a few seconds and at the touch of a hand on a spring loaded valve.

The drums are rolled onto the horizontal section of the ramp, and prevented from rolling off by raised stops at the end. They are positioned correctly by the stationary sides of the framework, so that they will roll straight ahead when the ramp is up. Two drums are placed on the ramp, and are lifted when air is admitted from the plant air line to the oil chamber thru a spring loaded valve. The ramp is raised to position such that the portion that was inclined attains the horizontal, placing the drums upon an incline that causes them to roll toward the opposite end of the unit. A metal plate is hinged to the end of the framework and is dropped to the bed of the truck, allowing the drums to roll onto the truck bed under their own power.

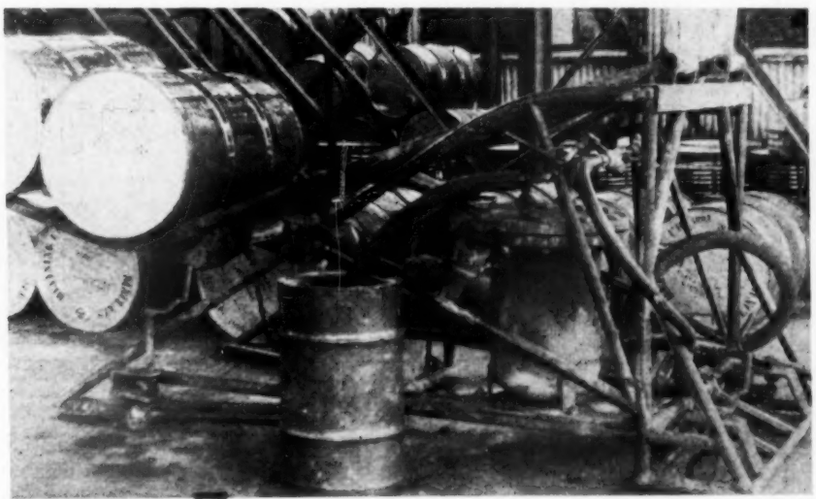
The power for lifting the ramp originates in the plant air system, which is used to apply air pressure to an oil supply in a vertical pot. The oil is forced from the bottom of the pot to a cylinder containing the hydraulic ram, which in turn raises the ramp. The cylinder is pivoted at the closed end so that it can rise as the ram is extended, following the swing of the ramp as it rises. A hose is used as a vent at the open end of the cylinder and its open end is placed in a convenient can which retains any oil that may leak past the piston. The ramp is lowered by opening a valve which vents the air pressure from the air pot, allowing the ramp to decend of its own weight. This vented air is also led into a can, to prevent any oil spray blowing on the operator.



Drum end of lift, showing ramp in lowered position. Control valves are at the right

Chains attached to the framework and the ramp on both sides snub the ramp and stop it in a horizontal position, preventing overtravel. The entire unit is mounted on four casters, which make the unit mobile when handscrews are turned down to put the weight of the unit on them; raising the handscrews removes the weight of the unit from the casters and lets the unit rest firmly on the ground. Steps are built into the unit on one side to enable one to climb to the truck bed easily.

View from truck end of lift shows closeup of oil pot (left) and cylinder housing for ram. Ramp is lowered by its own weight when the air pressure is released



As the ramp is raised and the inclined section comes to a horizontal position, the drums roll forward and are loaded onto the truck. Vent can and oil pot are shown in center. Unit rests solidly on the ground when actually in use, but can be raised onto four casters for mobility

Inexpensive Burette Dispenses LPG Odorant In Measured Amounts, Prevents Losses

Ethyl mercaptan, used as an odorant for liquefied petroleum gases to warn of gas escape, has a garlic-like aroma which will make any self-respecting skunk retire in disorder. A device for dispensing it in required amounts into shipments of liquefied petroleum gases, without the material coming into contact with either the hands or nose of the operator is therefore desirable.

An employee of Warren Petroleum Corp. has devised a pressurized dispensing burette for ethyl mercaptan which is not expensive to build, meters the $1.30-per pound odorant accurately, and precludes getting the chemical on hands or "normal" evaporation losses. In operation it has proved capable of reducing truck loading time, as the odorant may be added at any time during loading.

As shown in the drawing, the device consists of a storage tank for the chemical, capable of containing 100 lbs. of ethyl mercaptan, connected through suitable piping to a remotely-located vent, to a measuring burette, and thence to truck filling connections. High-pressure gas from the plant lines serves for injecting the odorant. The installation can be fabricated from materials commonly found around a natural gasoline plant or refinery and is largely a job of pipe-fitting.

Major items of equipment required for the tank are a 3½-ft. length of 12¾-in., 49-lb. steel pipe, two pieces of half-inch or heavier steel plate from which to form the ends, a 0-50 psi pressure gage and a pressure-relief valve connected to a vent-line. A quarter-inch pipe and valve, located at tank bottom, conducts chemical to the measuring burette; copper tubing may be used instead of steel pipe if desired.

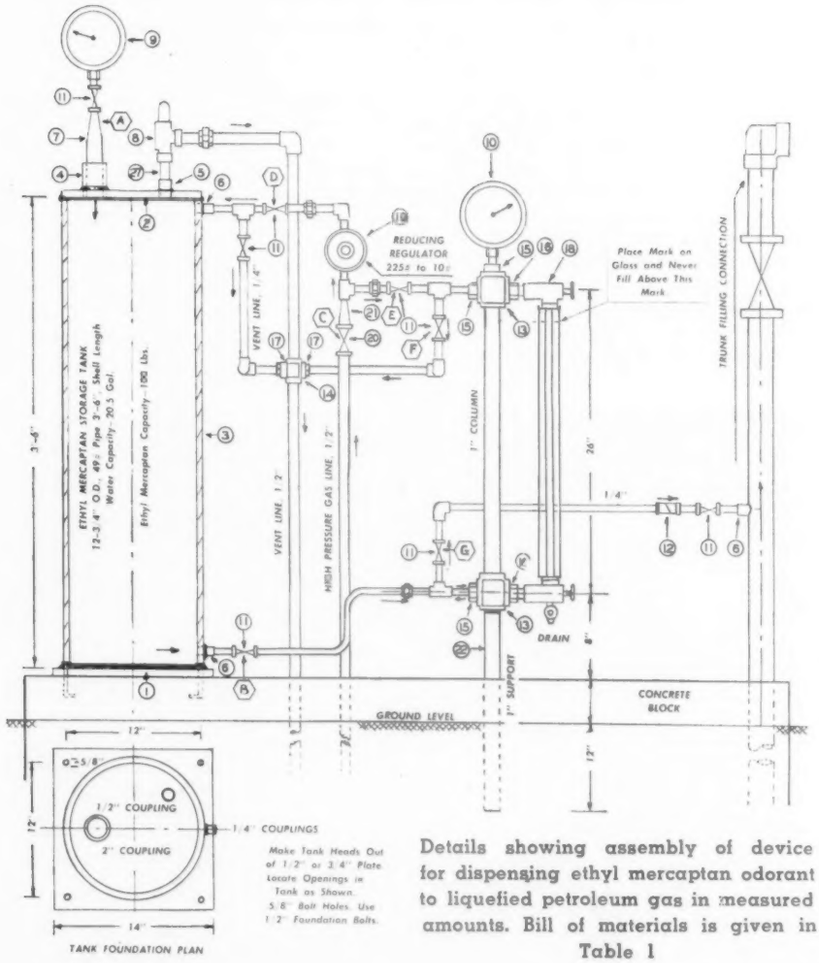
The measuring burette consists of a 1-in. column 28 in. long, made of steel pipe and connected through gage-glass cocks to a gage glass of similar length, marked by volumetric calibration in 54 cc. increments starting from an arbitrary "zero" mark near the top of the glass. A check valve is incorporated in the transfer line to the truck-filling connection so there is no possibility of liquefied petroleum gases backflowing into the odorant storage tank or measuring burette.

Bill of materials for the installation is shown in Table 1, keyed to the drawing by number.

TABLE 1—Bill of Materials for Odorant Dispensing Device

Item	No.	Size and Description
1	1	½ in. x 14 in. x 14 in. steel plate
2	1	½ in. x 12¾ in. dia. steel plate
3	1	12¾ in. OD x 42 in. length of 49-lb. pipe
4	1	2 in. extra heavy coupling
5	1	½ in. extra heavy coupling
6	3	¼ in. extra heavy coupling
7	1	2 in. x ¼ in. std. swaged nipple
8	1	½ in. relief valve set at 25 lbs.
9	1	pressure gage, 0-50 lbs.
10	1	pressure gage, 0-250 lbs.
11	8	¼ in. steel needle valve
12	1	¼ in. 250-lb. W.P. horizontal swing check valve
13	2	1 in. 300-lb. W.P. malleable cross
14	1	½ in. std. malleable cross
15	3	1 in. x ¼ in. steel bushings
16	2	1 in. x ½ in. steel bushings
17	2	½ in. x ¼ in. steel bushings
18	1	set of ½ in. 250-lb. W.P. gage glass cocks
19	1	¼ in. low capacity reducing regulator, 225 to 10 lbs.
20	1	½ in. 250-lb. W.P. steel needle valve
21	1	½ in. x ¼ in. swaged nipple
22	1	1 in. x 20 in. nipple (weld upper end shut; used as support only)
23	5	¼ in. 300-lb. W.P. tees
24	8	¼ in. 300-lb. W.P. ells
25	6	¼ in. unions
26	24	¼ in. x 3 in. std. nipples
27	2	½ in. x 3 in. std. nipples
28	1	½ in. union
29	2	½ in. std. ells

NOTE: Copper tubing may be used to replace ¼ in. pipe if desired.



Details showing assembly of device for dispensing ethyl mercaptan odorant to liquefied petroleum gas in measured amounts. Bill of materials is given in Table 1

Calibration and Operating

The burette is calibrated as follows (refer to sketch): The 1-in. column is filled with gasoline, by removing pressure gage 10, to the indicated arbitrary zero mark near the top of the gage-glass. Gasoline then is drained from the column through the gage-glass drain cock in increments of 54 cc, marking the gage-glass after each withdrawal. This quantity of ethyl mercaptan is sufficient to odorize 1000 gal. of LPG at the rate of 1 lb. per 10,000 gal.

In operation, the tank first is filled with 100 lbs of the chemical odorant by removing the nipple A, to which the tank pressure gage is connected, first making sure that all valves to the tank connections are closed. The nipple is securely replaced after filling is completed. Gas valves D and C then are opened slightly and reducing regulator 19 is set to provide gas pressure on the tank of from 5 to 10 psig. Tank

valve B then is opened, first making sure that valve F also is open, while valves E and G are tightly closed (E to prevent high-pressure gas flow into burette and G to prevent efflux of odorant to truck-filling connection). The 1-in. column is allowed to fill to the zero mark, when valves B and F are again closed.

High-pressure gas valve E is opened slowly until pressure on the burette-pressure gage indicates pressure exceeds the vapor pressure of the LPG being treated; valve G then is opened and odorant discharged into the truck loading line in required amount, which depends on truck capacity. G is closed after dispensing is complete and the cycle repeated for the next loading operation.

To refill the column, valve E is closed, F opened, and the column allowed to vent through the connection to the vent line. Original filling procedure then is followed and operations resumed. This is the only point, except for filling storage tank that the odorant can evaporate to atmosphere.

Improved Safety Practices Help Reduce Lost-Time Accidents, Increase Efficiency

Safer working conditions and fewer accidents are the result of improved safety practices in force at the Tutwiler refinery of Cities Service Refining Corp., Lake Charles, La.

One procedure which has been worked out involves the method of handling work permits, which Cities Service's plant protection department claims gives them a higher degree of supervision and increases the efficiency of permit issuance. A single type of permit has been devised, combining several earlier types—hot and cold work, gassy atmospheres, vessel entry.

The permit is issued jointly, in triplicate, by the plant protection and operating departments. Original goes to the supervisor on the job and the duplicate to the operating department foreman at the area involved; the third copy is retained by the safety department. Areas are visited by a safety inspector before a permit can be issued.

This type of administration permits the plant protection department (safety engineer) to know at all times the nature of every job being done in the refinery; it assures the workman that conditions surrounding the work have been inspected and found safe. In practice, workman can also be sure a safety inspector will visit him at least once during progress of the job to make sure conditions remain safe.

Another refinement used in this plant when any major repair job or unit turn-around is underway is the stationing of one or more safety engineers at the site until work is completed. In a catalytic cracker turn-around, for instance, two safety men are on the job during day and evening shifts when most of the work is in progress. At least one is on duty during the "graveyard" shift and more may be if necessary.

Safety men must continuously make safety checks of every job going on at the unit to see that working conditions are safe and remain so. Scaffoldings, for instance, carry placards placed immediately after erection by the safety engineer stating number of men and maximum weight permitted; carpenters and riggers have standing instructions to dismantle unplacarded scaffolding immediately and any other workman found on such scaffolding faces serious disciplinary measures.

Where men are working in a gassy or hazardous location at least one safety man is continuously stationed at the site with appropriate testing equipment. Where deemed necessary, a fireman also is present with the required equipment for fire control—from portable extinguishers to ready-laid foam hoses connected to the mains and ready for action at a moment's notice. Thus the men can concentrate on the job, knowing that every possible safety precaution is being maintained.

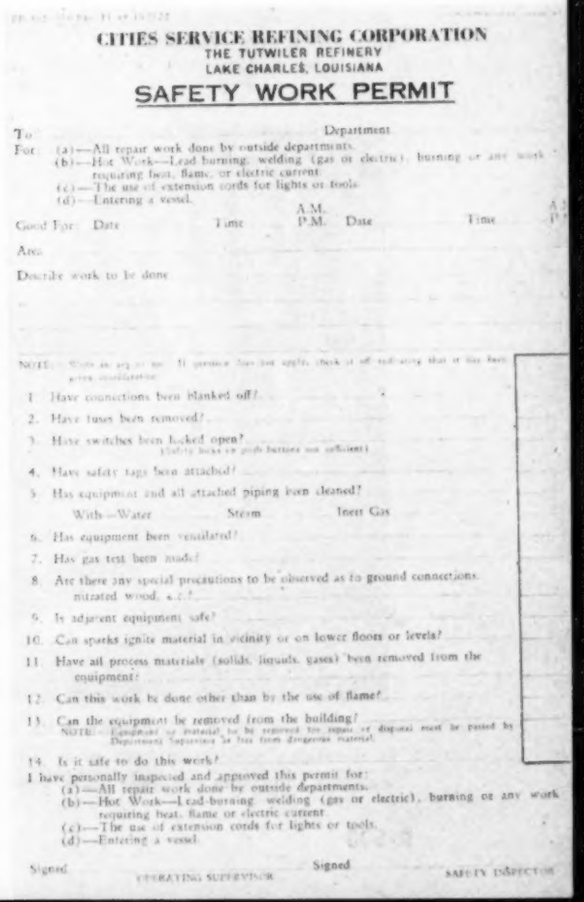
Still another safety-wrinkle being used is the monthly issuance of bulletins fully discussing every accident occurring in the period. Two types are used: One, of restricted circulation going to department executives only, giving entire personnel history of man and complete report of accident. The other goes to each foreman for circulation among his men, and discusses occurrence and prevention of each accident without naming or criticising the individual. In case of lost-time accidents, which have been kept few and far between, a complete investigational report covering all phases generally is made within 24 to 48 hours to the department and supervisory personnel concerned. This assures that immediate steps are taken to avoid recurrence. No fatal accident has occurred to refinery personnel since the plant first went on-stream about two years ago.

Wanted—IDEAS!

Plant operators, foremen and superintendents are invited to send in their own contributions of "how we do it around our refinery". Possible subjects could include maintenance and repairs ideas, inspection procedures, operating shortcuts — anything which has made your refinery more efficient and easier to run. Include photographs, drawings or sketches, if available.

Material accepted for publication will be paid for at our regular space rates. Contributions should be addressed to:

Plant Practices Editor
National Petroleum News
Technical Section
1213 West Third Street
Cleveland 13, Ohio.



CITIES SERVICE REFINING CORPORATION
THE TUTWILER REFINERY
LAKE CHARLES, LOUISIANA

SAFETY WORK PERMIT

To _____ Department

For (a)—All repair work done by outside departments.
(b)—Hot Work—Lead burning, welding (gas or electric), burning or any work requiring heat, flame, or electric current.
(c)—The use of extension cords for lights or tools.
(d)—Entering a vessel.

Good For: Date _____ Time A.M. P.M. Date _____ Time A.M. P.M.

Area _____

Describe work to be done _____

NOTE: Write in any of the following that apply, check off all indicating that it has been given consideration.

1. Have connections been blanked off?
2. Have fuses been removed?
3. Have switches been locked open? (Safety locks or pole barriers not sufficient)
4. Have safety tags been attached?
5. Has equipment and all attached piping been cleaned? With—Water Steam Inert Gas
6. Has equipment been ventilated?
7. Has gas test been made?
8. Are there any special precautions to be observed as to ground connections, nitrated wood, a.c.?
9. Is adjacent equipment safe?
10. Can sparks ignite material in vicinity or on lower floors or levels?
11. Have all process materials (solids, liquids, gases) been removed from the equipment?
12. Can this work be done other than by the use of flame?
13. Can the equipment be removed from the building? NOTE: Equipment or material to be removed for repair or disposal must be passed by Department Supervisor as free from dangerous material.
14. Is it safe to do this work?

I have personally inspected and approved this permit for:
(a)—All repair work done by outside departments.
(b)—Hot Work—Lead-burning, welding (gas or electric), burning or any work requiring heat, flame or electric current.
(c)—The use of extension cords for lights or tools.
(d)—Entering a vessel.

Signed _____ OPERATING SUPERVISOR Signed _____ SAFETY INSPECTOR

This type of uniform work permit, used at Cities Service Tutwiler refinery for all types of "outside" repair work, permits a greater degree of supervision and is more efficient, according to the company's plant protection department. Before a permit can be issued the working areas involved must be checked by a safety inspector to make sure that working conditions are satisfactory

Exhaust Steam Condenser Built from Scrap Is Typical of 'Home Made Refinery Gadgets'

By ROY W. MACHEN—Supt., Hammon Oil & Refining Co., Bay City, Texas

The introduction of home made or "refinery built" pieces of equipment into the scheme of refinery and gasoline plant operations during the recent war by the larger companies and the previously "engineered" plants was at first a very doubtful innovation. However, as time went on and more and more "refinery built" gadgets became necessary to the continuity of plant operations, these home made items began to prove their overall value.

As the pace of refinery operations increased, one of the smaller Gulf Coast refineries found need for an exhaust-steam-to-water condenser for the usual purposes of increasing the recovery of steam condensate that could be used as feed-water for the boilers. The exhaust steam had primarily been connected up so that it exhausted into the conventional tank type hot-well. Previous to the stepping up of operations the condensation secured had been sufficiently gratifying. However, with increased throughput the steam consumption became greater and consequently so did the percentage of raw water that was necessary in the boiler make-up supply. As the amount of exhaust steam became greater the conditions essential to the successful condensation of a portion of the exhaust steam became so unbalanced that the need for additional steam condensing area was vital.

A new factory-made condenser was out of the question. In fact, it was not possible to obtain one. An inventory of stocks lying in the plant yard turned up a piece of 36-in. pipe with ⅜-in. walls and 16 ft. long, two shorter pieces of the same pipe, sufficient ¾-in. plate to make flue sheets to fit at either end of the 16-ft. piece of 36-in. pipe, and sufficient 1-in. pipe to furnish a tube bundle through which to contact the exhaust steam with a constant stream of water flowing from the various coolers in the plant to the overhead spray connections in the cooling tower. The resulting condenser is shown in the accompanying photograph.

The condenser proper consisted of a shell 16 ft. long with flue sheets drilled to accommodate 1-in. pipe for rolling and a light bead. The flue sheets were inserted into the shell with the outer edges flush with the ends of the shell. After the flue sheets had been solidly welded into place, the 1-in. tubes were inserted into the provided holes, rolled into the sheet and then lightly beaded with the electric torch. The tubes were spaced so as to get the maximum possible number into the 36-in. sheet when leaving a web or ligament between the tube holes of 1 in.

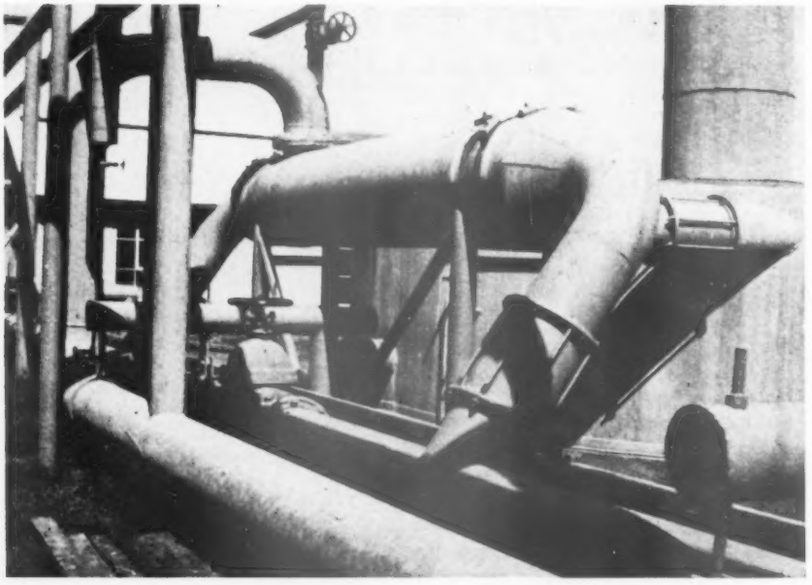
The two shorter lengths of 36-in. pipe were then welded to the ends of the shell. At a point 24 in. from the weld they were swaged down to 12 in. by making a series of cuts, shapings, and welds, as is clearly shown in the photograph. A 12-in. tube turn (long radius) and a short 12-in. nipple completed the details. Both ends of the condenser were constructed in the same manner.

In order to provide water connections for either end of the bundle, short 12-in. stubs were welded into the existing 12-in. return water line to the cooling tower and a gate valve was inserted in the line to provide a shut off so that the entire flow could be diverted through the condenser.

The only valve available was a 10-in. valve. Since the available companion flanges were threaded, short 10-in nipples were screwed into these companion flanges, and these nipples were then welded onto the half pieces of the "sleeve" of the dresser coupling after it had been cut into. This made a rather peculiar style of fitting, the valve being fitted on either side with a companion flange and a short 10-in. nipple welded to half of a dresser sleeve, which was drawn up into place by the use of the regular rings. The bolts used to draw up the rings against the rubber ring packing had to be adapted to the conditions existing, by using standard ⅝-in. x 8-in. machine bolts, and welding the nuts to the special "swaged dresser" sleeve.

A 12-in. welding neck flange was inserted in the top of the condenser shell to provide an inlet for the exhaust steam. As can be seen in the photograph, the exhaust steam line made a loop up, over and down into the top of the condenser where this flange had been provided. At the other end of the condenser and on the side facing the hot well tank and tangentially to the shell was welded an outlet consisting of a short 12-in. nipple. A short nipple welded into the tank tangentially provided the connection for the outlet from the condenser; this connection was solidified by means of a standard 12-in. long sleeve dresser coupling.

In order to provide for inspection openings and possible tube rattling availability, two manholes were cut in the top of the "shell-like" ends that had been welded to the shell proper and swaged for the 12-in. connections at either end. These two openings were made of such a size that a standard 11-in. x 15-in. "oilfield" type boiler manhole gasket would fit and could be held in place by means of a cover plate cut from a scrap piece of the 36-in. pipe. These plates were held securely in place by means of bolts welded at short intervals around the outer edge of the cover plate and lugs provided with short legs on one end so as to permit a full surface bearing when drawn into place with regular machine bolt hex nuts. When this condenser was put in service the condensate return quite soon rose to pre-war normal percentages.



This exhaust steam condenser, with an exchanger section 16 ft. long and 3 ft. in diameter, was built from odds and ends lying around the plant yard when wartime shortages precluded the possibility of buying a new factory-made one

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" " 200 "	32	56	80
" less than 40 microns	17	33	50
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Average particle size . . .	115 microns	65 microns	40 microns

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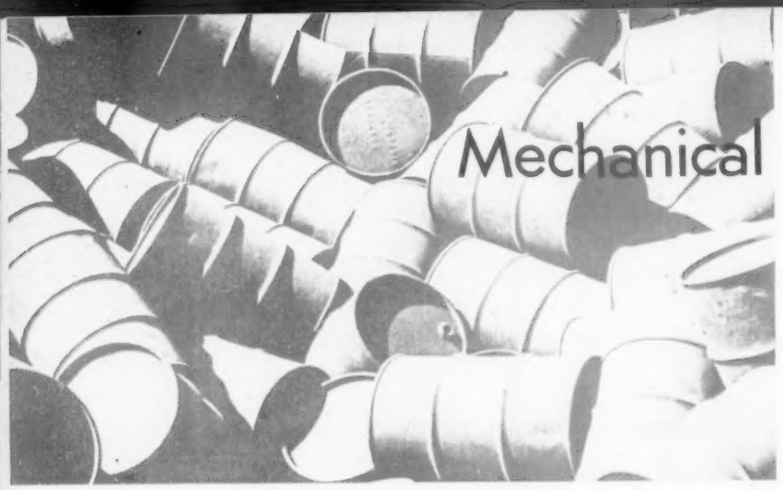


Mechanical Barrel Washer 'Launders' 60- Turns Them Out Ready for

General Design, Construction and Operating Details for a Home-made Refinery Barrel Washer Which Cleans and Dries Used Lubricating Oil Containers

CLEANING used oil drums preparatory to reuse is now done more quickly and with less trouble in one Mid-Continent refinery with a mechanical barrel washer, designed and built in the plant. This washer handles 20 55-gal, or smaller drums at a time, and cleans and dries them both outside and inside in from 15 to 20 minutes.

Before the mechanical washer was put into operation, the plant cleaned its barrels by rolling them (with bungs in) around by hand in a large tank filled with hot cleaning solution. When clean, they were moved to a second tank of rinse water. The bungs were then removed and the barrels up-ended over a hot-water jet and cleaned inside. This was followed by air-drying prior to going to the paint shop.

Such a procedure took a lot of time, required individual handling of each barrel, and was unpleasant work.

As a result it was decided to build a mechanical washer from salvaged parts to be found around the plant. The plan was to hold the drums on a rotating carrier or table inside a steel shell, and to include provision for spraying them with chemical cleaning solution and rinse water on the outside, and steam and water on the inside. Air-drying facilities were also to be provided. General details of the resulting design are shown in Figs. 1 and 2.

Set on Concrete Bowl

A conical concrete bowl 50 in. deep, the top of which is 4 in. above ground-level, was first poured (Fig. 1). A drain protected by a screen was provided in the bottom to return solutions to storage for recirculation, and also a hole through which the shaft was extended for driving the barrel carrier. Shell of the washer was made from sheet steel salvaged from abandoned tankage. It is 5 ft. high and has a conical roof carrying a short piece of 10 in. pipe closed with an outside disc-flap for venting internal pressure. A small door in the shell provides access for loading and unloading barrels. To avoid collapse of the shell from vacuum if rain should suddenly cool the unit while it is in operation a short piece of 6 in. pipe, closed with an inside disc-flap, was installed.

The barrel carrier consists of a circular structural steel platform, supported on ten cast-iron wheels revolving on a track made of steel channels and bolted to the concrete base. It is attached to a vertical shaft supported on two bearings and driven by a bevel-gear and pinion, as shown in Fig. 1. The angle-iron railing superstructure is provided as a leaning-support for the barrels, since it is necessary to incline them slightly (5 to 10°) to counteract centrifugal force developed when the turntable is rotating at about 5 rpm. The only piping on the carrier is the connection to each barrel for internal washing. This is a simple ten-arm spider as indicated in Fig. 2, which is a top view of the turntable.

Table Turns at 5 RPM

The table is driven by a 5 hp 1200 rpm AC motor through a speed reducer and chain-and-sprocket drive to the horizontal shaft shown entering the bottom of the washer in Fig. 1 and engaging the vertical shaft through a bevel-gear and pinion. The speed reducer gives approximately a 30:1 reduction, the gear and pinion about 8:1. Thus turntable speed is roughly 5 rpm. Speed reducer and motor, which formerly drove a slow speed agitator on a lube oil chiller were salvaged when the lube plant was modernized several years ago. Bevel gear and pinion likewise were "surplus" items.

Balance of the piping springs from two circular 3-in. headers, located respectively above and below the carrier; top header is 13 ft. in diameter, the bottom, 10 ft. Each, as shown in Fig. 1, carries 20 pairs of nozzles, the nozzles being aimed in such a manner as to strike opposing sides of the barrel (55-gal. size) at the top and bottom corners. Both headers are supplied, alternately, from chemical or wash water tanks.

Two centrifugal pumps supply circulation (Fig. 3) for the washer, both direct-connected to a 5 hp utility motor through a common shaft. One takes suction through a header to either chemical or wash water storage tanks as required, discharging through a closed steam-to-liquid heat exchanger to both top and bottom headers in the washer. (As originally designed, this was an open exchanger; it was abandoned when the cleaning solution proved to be picking up too much water.) Storage tanks

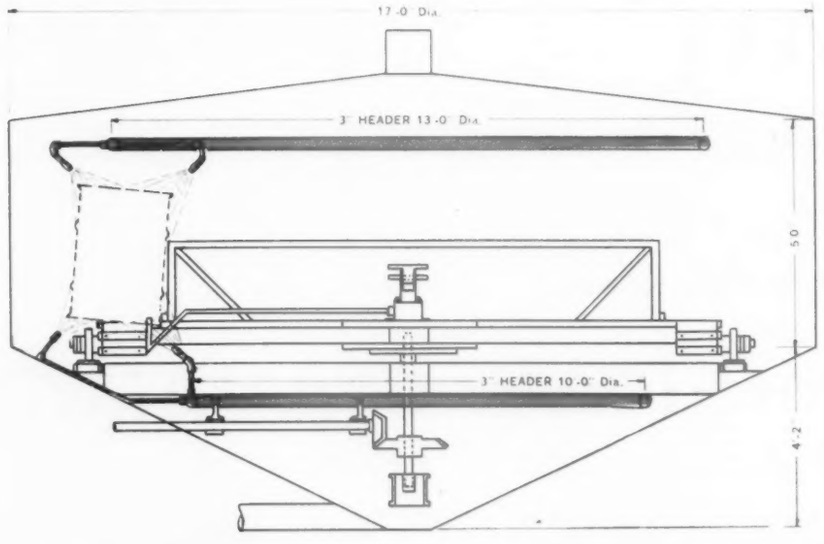


Fig. 1—General details of design and construction of mechanical barrel washer, showing cross-sectional view of shell and barrel carrier, and the arrangement of top and bottom sprays for external cleaning and rinsing

60-80 Drums an Hour, for Painting

are elevated sufficiently above the pump to maintain gravity prime. The other takes suction from the bottom of the washer, again by gravity prime, and discharges through another header into one or the other of the two storage tanks.

For convenience, motor control switches and all header valves are located at a point close to the door of the washer. Motors and pumps, however, are located in the basement of the adjacent barrel house. Here they are protected from the weather but are easily accessible for maintenance. Also, this permits the pumps being located considerably below the level of the washer drain and storage tanks, assuring their being primed at all times without necessity of digging a pit.

Accommodates 15 to 55 Gal. Containers

In operation, the barrels are loaded into the washer through the door, the turntable being "humped" around several times so that all points are loaded. Any size container, from 15 gal. drum to 55-gal. barrel, is accommodated. Barrels are placed bungs down, the bung being placed over the tip of the pipe from the carrier header for internal washing. When the table is loaded, rotation is started with the door left open until carrier is up to speed, to observe whether or not any barrels are thrown off by the sudden jerk. When small drums are being washed, it is necessary to "hump" the table several times in bringing it up to speed, to avoid throwing them off and denting them or jamming the table.

Cleaning solution is admitted through top and bottom sprays at either 200° F. or the temperature recommended by the manufacturer of the cleaner being used. Solution is applied for approximately 10 minutes or until paint is removed, followed by rinsing with water, after which header valves are closed. Barrels are cleaned inside by hot water and steam from the turntable header, never with chemical, and dried with plant air. Since the barrels are hot, the air also serves to dry them on the outside and, when removed from the washer, they are ready for the paint shop without further attention.

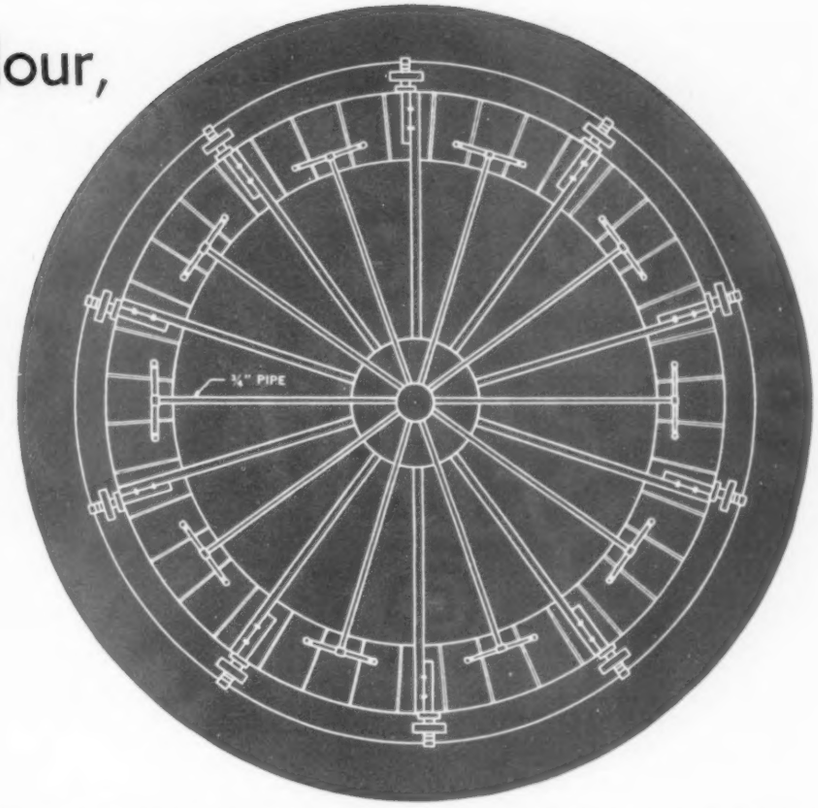


Fig. 2—View looking down on the barrel carrier, showing the location of piping for internal washing of barrels, position of supports on turntable, and location of trucks

Cleaning Complete in 15-20 Minutes

Ordinarily, the whole cycle is completed in from 15 to 20 minutes. Occasionally a "stubborn" barrel is encountered which will not respond to this cycle; it is left to go through the process again. Under no circumstances is the inside of a barrel ever cleaned with chemical, to avoid possible contamination of the product with which it will subsequently be filled. Since the former contents were a lubricant, hot water and steam is all that should be necessary.

A considerable saving in labor results from the use of this washer. An operator is required only to load and unload the barrels and operate the valves. It was constructed at minimum expense by using material already on the plant surplus list. Indeed, about the only items which had to be purchased were concrete, the spray nozzles and the castings from which the turntable bearings were made. Steel for the shell and much of the structural steel support came from old tankage; the rest came from the plant salvage pile, including piping, angle irons and other miscellaneous items. Entire fabrication was by welding.

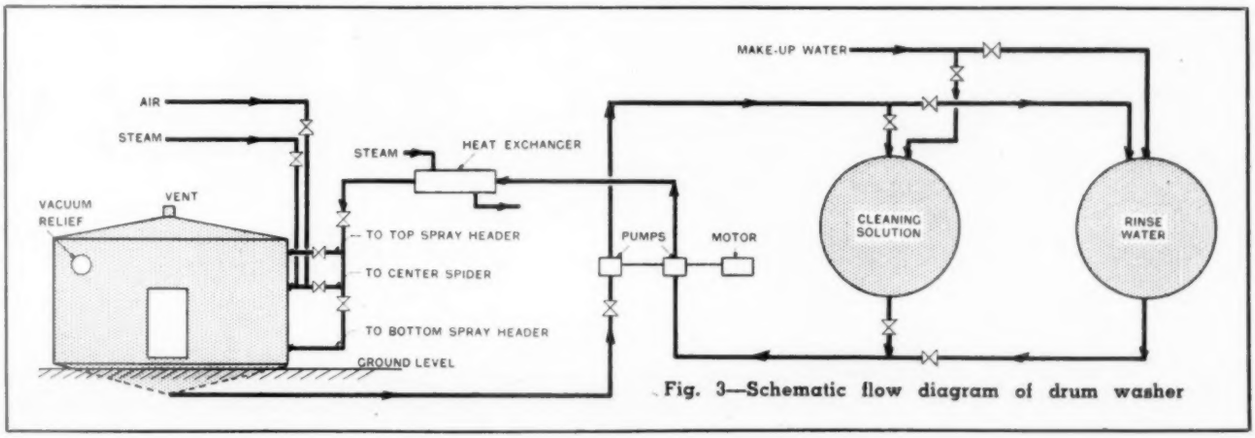
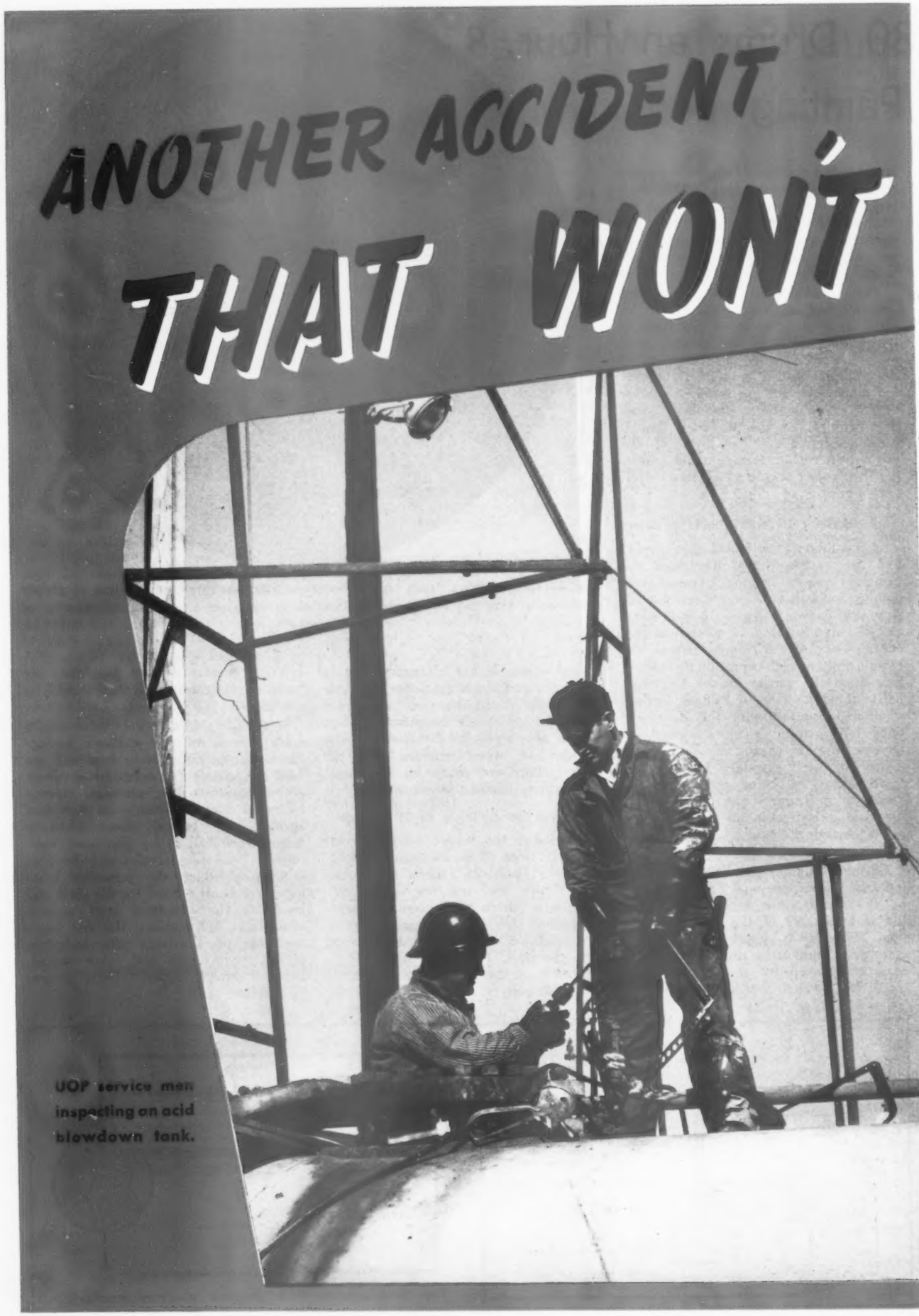


Fig. 3—Schematic flow diagram of drum washer



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THE NEW HYDROCOL PROCESS

Described as Means for Bringing Dry Natural Gas into Competition with Crude Oil in the Manufacture of Gasoline and Other Products*

By P. C. Keith
President, Hydrocarbon Research, Inc.

First details are given of the adaptation in this country of the German Fischer-Tropsch process to (1) the conversion of natural gas to a carbon monoxide and hydrogen mixture and (2) the production from this mixture, by catalytic reaction, of gasoline and other liquid hydrocarbons.

First commercial application of the Hydrocol process is to be made at a $15,000,000 plant at Brownsville, Texas, in which several oil companies are participating. Development work was done at a 10 b/d experimental plant at Olean, N. Y., and on a larger scale at Montebello, Cal. The Brownsville plant is planned to produce gasoline at a cost of 5.25 cts. per gal. and other liquid products. The Hydrocol process it is said will also make available cheap oxygen for the chemical and metallurgical industries and provide low cost chemical materials, particularly carbon monoxide, hydrogen and oxygenated hydrocarbons.

Potential possibilities for converting dry gas into liquid products, in view of our huge underground gas reserves, in effect will double our known underground oil reserves, it is claimed. Natural gas will begin to compete with crude as raw processing material. Long range possibilities of the Hydrocol process are seen in the gasifying of coal at the mines and piping it to markets in competition with natural and manufactured gas.

CONSIDERABLE interest has been exhibited of late in the possibility of developing a process for making gasoline from natural gas at a cost competitive with the cost of gasoline from crude oil. Such a process would make natural gas this country's first important source of motor fuel independent of petroleum.

The need for a substitute oil source grows steadily as withdrawals from our crude oil reserves continue to exceed the rate of discovery of new deposits. The situation was of course aggravated by World War II, but it promises to remain a point of real concern in the post-war period. Just how long it will be before we face a really serious crude oil shortage is a matter of conjecture, but this much is certain: Our oil reserves are dwindling.

The proven reserves of natural gas, on the other hand, have increased materially in recent years and the indications are that this trend will continue. In fact, the present production rate is only half the rate of discovery. If the production rate were doubled, thereby approximating the rate of discovery, and if this incremental production were converted to gasoline and oil, motor fuel production would be stepped up by 25%. Given a satisfactory natural-gas-to-gasoline process, then, it is evident that natural gas could become an important factor in the country's oil economy.

Furthermore, the manufacture of gasoline from coal is only one step removed from the manufacture of gasoline from natural gas. With our huge coal reserves, an economic coal-to-gasoline process would have the effect of underwriting this country's gasoline and oil requirements for centuries to come.

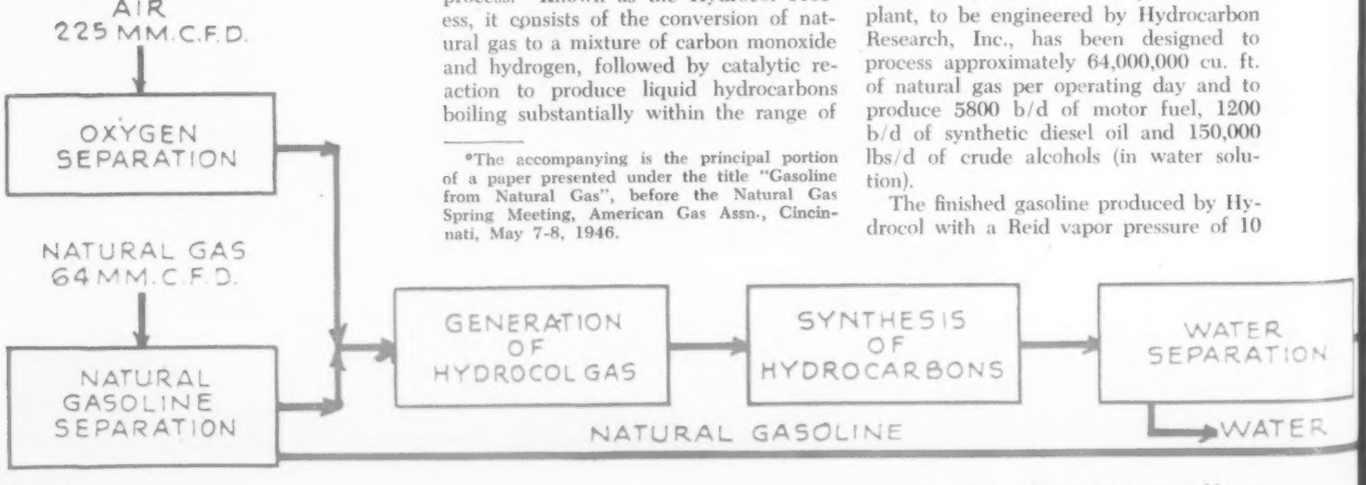
Hydrocarbon Research, Inc. has developed an economic natural gas-to-gasoline process. Known as the Hydrocol Process, it consists of the conversion of natural gas to a mixture of carbon monoxide and hydrogen, followed by catalytic reaction to produce liquid hydrocarbons boiling substantially within the range of gasoline. By-products are high-grade diesel oil and oxygenated compounds such as alcohols.

The Hydrocol Plant

The first commercial application of the Hydrocol Process is to be made by Carthage Hydrocol, Inc. in a plant soon to be erected at Brownsville, Texas. This plant, to be engineered by Hydrocarbon Research, Inc., has been designed to process approximately 64,000,000 cu. ft. of natural gas per operating day and to produce 5800 b/d of motor fuel, 1200 b/d of synthetic diesel oil and 150,000 lbs/d of crude alcohols (in water solution).

The finished gasoline produced by Hydrocol with a Reid vapor pressure of 10

*The accompanying is the principal portion of a paper presented under the title "Gasoline from Natural Gas", before the Natural Gas Spring Meeting, American Gas Assn., Cincinnati, May 7-8, 1946.



lbs. has a clear octane number of 80 CFRM or 88-90 CFRR. This quality of gasoline compares favorably with that produced by catalytic cracking of distillate fractions from petroleum. The diesel oil has a gravity of about 38° API, a cetane number of 45-50, and a pour point below 0° F. The oxygenated compounds in water solution consist mainly of acetaldehyde, acetone, and ethyl, propyl, butyl, amyl and heavier alcohols. This last product offers an extremely attractive source of chemical raw materials.

The Hydrocol Process calls for the following operations:

(1) The recovery of approximately 0.25 gal. of natural gasoline and butane per 1000 cu. ft. of feed gas. (Recovery of this natural product becomes economical only as an incremental operation of the Hydrocol Process.)

(2) The separation of 40,000,000 cu. ft. per day of high purity oxygen from air.

(3) The partial combustion of 64,000,000 cu. ft. per day of natural gas with the high purity oxygen to produce a mixture of carbon monoxide and hydrogen.

(4) The conversion of this mixture of carbon monoxide and hydrogen—called Hydrocol gas—into gasoline and other synthetic products.

(5) The separation of the gasoline and other synthetic products by fractionation and absorption techniques.

(6) Treatment of the gasoline to remove oxygenated compounds, polymerization of the propylene and butylene, rerunning, blending, etc.

(7) The manufacture and revivification of catalysts.

The Carthage Hydrocol plant is scheduled to be in operation late in 1947 and will cost an estimated $15,000,000. Allowing credit for the diesel oil at 3.5c per gal and for the crude alcohols at 0.5c per lb, it is predicted that the "out-of-pocket" cost of the gasoline will run about 2.5c per gal. This cost includes all expenses and charges exclusive of capital costs. When capital costs, including interest, depreciation and amortization, are added, the cost of the gasoline becomes 5.25c per gal.

This figure compares favorably with figures for producing gasoline of similar quality from crude oil at today's crude prices. Discounting any advantages which would result from a probable increase in the price of crude, it is obvious that the most fruitful avenue for improvement in the economics of the process is in the reduction of capital cost. Substantial reductions in the cost of future Hydrocol plants seem probable.

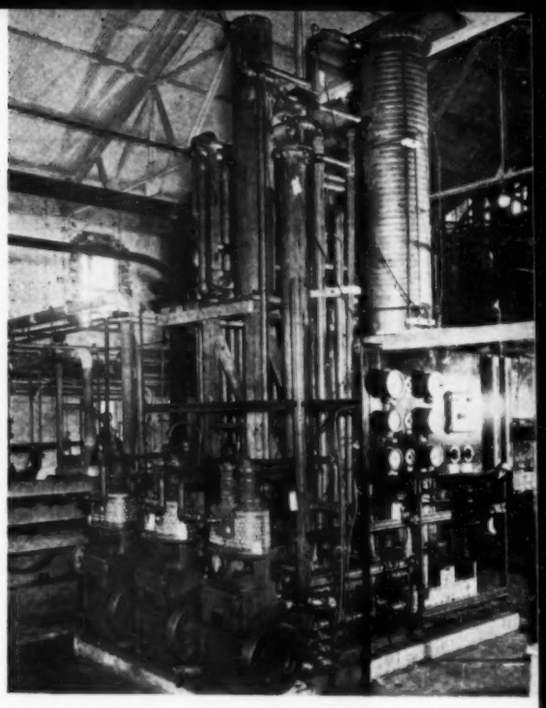
(A section of the Keith paper, entitled "History of the Process" is omitted here. This section reviews briefly the development work over 25 years in the Fischer-Tropsch process as applied to coal conversion, including the adaptation by the German I. G. Farbenindustrie which produced suitable carbon-monoxide-hydrogen mixtures by burning low grade brown coal with steam and oxygen.

The oxygen, 98% pure, was produced by I. G. by the Linde-Frankl process, which involves compressing and liquefying air and then separating the oxygen from the nitrogen by fractionation. Moisture or carbon monoxide is eliminated from the air mechanically, rather than by chemical treatment. Much of the economy of this method of oxygen production arises from the fact that upwards of 96% of the fresh air needs only to be compressed to about 75 psig. The paper continues:—Editor)

With natural gas as the starting material in place of coal or Braunkohle, the natural gas can be converted either by direct burning in oxygen or by reaction with steam in an indirectly-fired retort. The latter method is the familiar steam-methane process used in the synthetic ammonia and synthetic methanol processes. The steam-methane process requires a prohibitively high capital cost as well as an excessive consumption of methane. It was, in fact, the realization that cheap oxygen and direct burning of the natural gas afforded the only economic method of producing the carbon monoxide and hydrogen mixture required for synthesis that led Hydrocarbon Research to spend so much effort and money perfecting the oxygen plant and the direct combustion method.

In the hydrocol plant to be erected at Brownsville, preheated natural gas and oxygen will be reacted at 250 psi. in the generator to produce the carbon monoxide and hydrogen mixture known as Hydrocol gas. Experimentation at Olean, N. Y., in a 10-b/d semi-commercial plant, and on a larger scale at Montebello, Cal., has shown that the reaction goes smoothly and controllably.

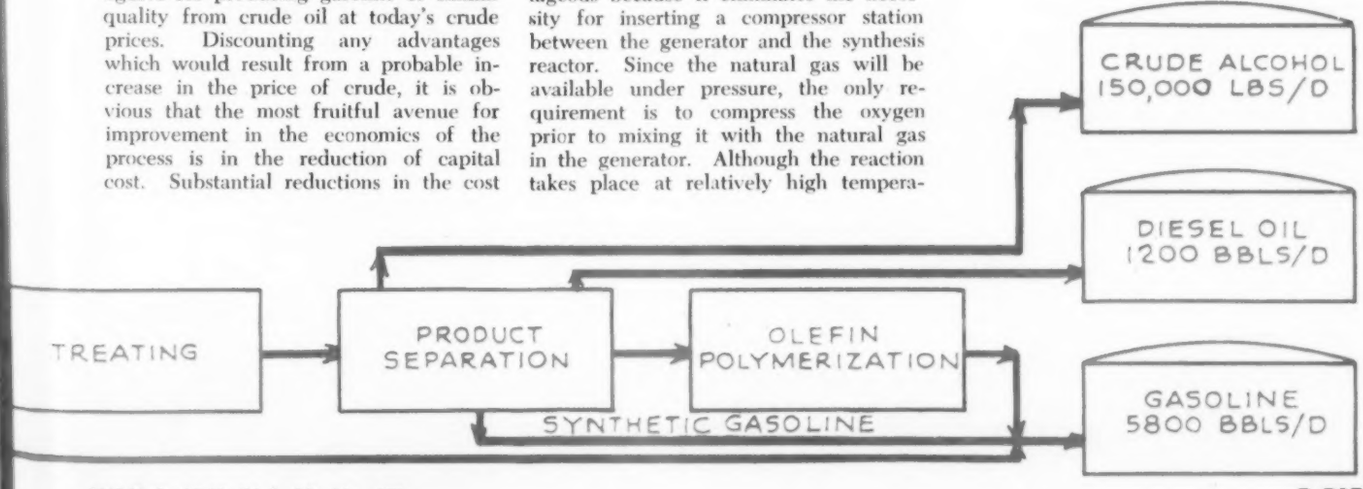
Operating at this pressure is advantageous because it eliminates the necessity for inserting a compressor station between the generator and the synthesis reactor. Since the natural gas will be available under pressure, the only requirement is to compress the oxygen prior to mixing it with the natural gas in the generator. Although the reaction takes place at relatively high temperature, the metal shell temperature can be maintained safely within accepted working limits by the proper selection of insulating materials and the introduction of vapor stops.

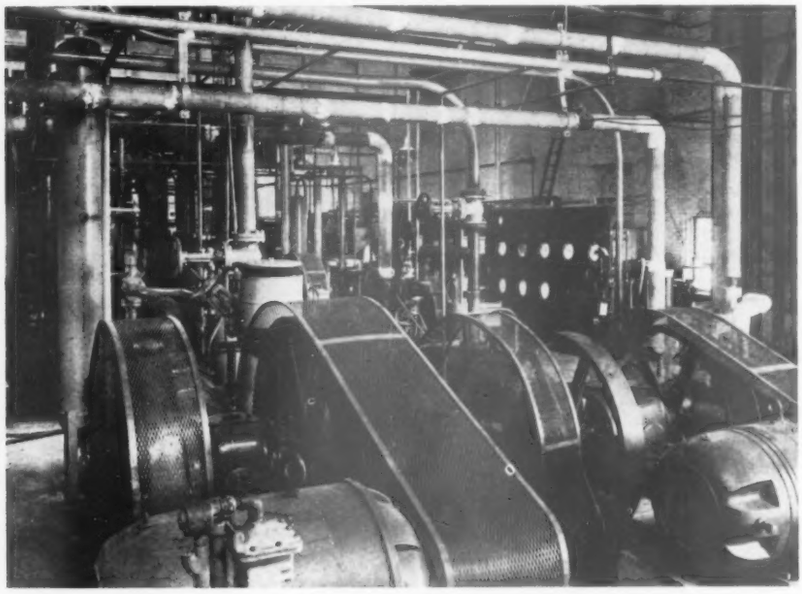


View of the experimental oxygen plant of Hydrocarbon Research, Inc., at Olean prior to insulation. This unit produced 10,000 cu ft. per day of oxygen: the full-scale plant will produce 40,000,000 cu. ft. per day

It is of interest that the oxygen unit of the Brownsville plant will be the largest ever built. Compressing air to 75 lbs, it will produce 40,000,000 cu. ft. per day of oxygen at an estimated cost of 4.8c per 1000 cu. ft. This figure is based on an investment of $3,500,000 for the plant (including construction labor, materials, etc.) amortization at 12½% per year, maintenance at 4% per annum, and two operators per shift. Power (amounting to less than 14 KW per 1000 cu. ft. of oxygen) and water costs are excluded, since they are both available as by-products of the process and are automatically covered in the price paid for natural gas.

As will be developed later, this oxy-





Compressors and panel board at the Hydrocarbon Research pilot plant at Olean. The Hydrocol synthesis gas is produced by reacting preheated natural gas and oxygen at a pressure of 250 psi

gen development should be of real interest to the gas industry, since it promises not only to materially lessen the cost of making "city gas" but to open up the possibility of completely gasifying coal and producing therefrom a 1000 BTU pipe line gas.

(Historical data on the second step in the Hydrocol process, the catalytic reaction of the carbon monoxide and hydrogen mixture known as Hydrocol gas to produce gasoline and other hydrocarbons is omitted here. The German commercial plants, the first of which was built in 1933, used as catalysts, first, nickel-manganese-aluminum oxide mixture on kieselguhr; second, a cobalt-thoria-kieselguhr preparation.

Shortcomings of the German method of synthesis are listed in the Keith paper as: high cost and various operating difficulties with the catalysts; conversion of carbon monoxide to useful products was only about 40% of the theoretical; complicated design of the reactors; low octane number, about 40, of the gasoline produced. The paper continues:)

From a detailed study of German designs and operating data it became clear that the only way to lower the costs of the process was to improve its efficiency. This involved finding both a cheaper and more efficient means of heat transfer and a catalyst that would operate at a higher space velocity, the catalyst and the reactor design being interdependent.

For example, if the catalyst temperature must be controlled within 25° F. to maintain activity and product distribution, a minimum quantity of cooling surface must be provided on the basis of a reasonable transfer rate. This in turn fixes the maximum space velocity allowable, assuming that the catalyst activity is not limiting. For example, the heat liberation for 90% reaction of one cu. ft. of synthesis gas is about 55 BTU; at a space velocity of 100 the hourly duty would be 5500 BTU per cu. ft. of catalyst space. With a transfer rate of 10 BTU/sq. ft./hr./° F. and a mean temperature difference of 10° F., the cooling surface required would be 55 sq. ft. These conditions approximate the best design of Ruhrchemie.

It is immediately obvious, then, why space velocity in such a reactor as the Ruhrchemie design is definitely limited. Raising it will increase the heat load, and hence the temperature, so that either product distribution will suffer (i.e., fixed gas production will increase) or the catalyst will become fouled with coke. Also, under ideal conditions in such a system, localized hot-spots can still occur. In fact, there is experimental evidence that the true catalyst temperature in a fixed bed system is at least 75-100° F. higher than the observed gas temperature and that at isolated points it is much higher.

There can be no question that catalyst activity has seldom been the limiting factor. More often it has been the efficiency of removal of the heat of reaction. In other words, with adequate heat removal, the space-time yield of oil is potentially much greater than anything that has ever been realized. It was on the basis of this conclusion that engineers of Hydrocarbon Research suggested a program of experimental work in which the space-time yield of oil would be studied as a function of space velocity and cooling surface.

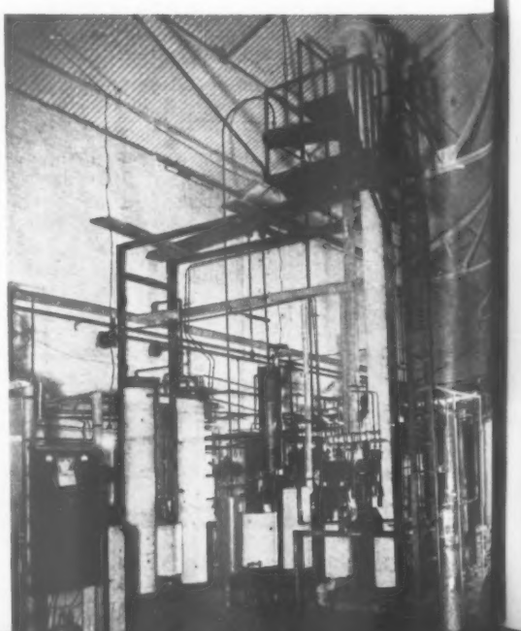
In reviewing the work done by Ruhrchemie and I. G., it became apparent that one possible way of improving markedly the space-time yield of oil was to use the fluid or powdered catalyst technique. With the fluid process, it will be recalled, the catalyst is ground to a very fine powder (approximately 75-80% finer than 325 mesh) and is then maintained in a state of turbulence by aeration with regulated quantities of gas. When the powder is properly prepared, it can be aerated or partially suspended by the gas and assumes many of the properties of a boiling liquid. For example, there is a constant motion of the particles and, while the surface of the bed of powder is reasonably fixed, local eruptions of bubbles are evident. Furthermore, the powder flows freely, exerts a static head, and is compressible. Among the advantages of the fluid catalyst technique are: (1) temperatures can be controlled within 5-10° F., (2) the catalyst itself is utilized as a medium of heat transfer, and (3) processes using the fluid catalyst are continuous, since any decline in activity can be compensated by withdrawal of a portion of the catalyst and replacement with fresh material.

Before embarking on a program of experimental work to determine the feasibility of the fluid catalyst technique for the synthesis reaction, it was concluded that the use of a cobalt catalyst was impractical because of the high cost, the limited amount of cobalt available, and the low-octane number of the gasoline. Accordingly, attention was directed to cheap, rugged, iron catalysts.

Experimental Work

The Hydrocol plant to be erected at Brownsville has back of it over $1,000,000 of experimentation carried on at Hydrocarbon's experimental station at Olean. The 10-b/d semi-commercial plant built and operated at the experi-

General view of the 10 b/d Hydrocol Process experimental pilot plant of Hydrocarbon Research, Inc., at Olean, N. Y. The full-scale plant to be erected at Brownsville, Texas, and scheduled to be in operation late in 1947, will produce 5800 b/d of motor fuel



mental station contains all the elements of a commercial plant:

(1) A continuously operating low pressure oxygen plant with a capacity of approximately 10,000 cu. ft. of oxygen per hour.

(2) Pressure generators for the burning of natural gas with oxygen to produce Hydrocol gas.

(3) The synthesis reaction system.

(4) A product recovery system.

(5) Facilities for de-oxygenating the gasoline produced.

Hydrocarbon Research, Inc. started its development work convinced that the Fischer-Tropsch process was fundamentally sound but was woefully lacking in good engineering design. It seemed obvious that the application of modern chemical engineering practice, as typified by the process installations of the petroleum industry in this country, would result in marked improvements in efficiency. In fact, it appeared probable that such engineering improvements would make the process economic in the U. S., using natural gas as the immediate raw material.

The principal conclusions from the research and development work were:

(1) The oxygen plant design is sound and oxygen can be produced by the hydrocarbon cycle efficiently and at relatively low cost.

(2) Natural gas can be burned directly with oxygen to produce Hydrocol gas. The operation is controllable and the product gas is free of soot.

(3) The fluid catalyst technique more than confirmed expectations with regard to heat control, and is certainly the most economic method of operating the process.

(4) The exothermic heat of the reaction is almost totally recoverable in the form of high pressure steam. The Carthage plant will produce upwards of 750,000 lbs./hour of high pressure by-product steam.

(5) Conversion of Hydrocol gas of better than 90% are obtainable with a cheap, rugged catalyst.

(6) The yield of oil, based on carbon monoxide reacted, is higher than that obtained by any German investigation, and the treated gasoline is of a premium quality.

(7) The allowable space velocities, and hence the space-time yields, are order of magnitude greater than any achieved in Germany.

(8) The yield of gasoline can be readily controlled to constitute better than 80% of the total useful products

(9) There are no real difficulties or novel methods required in separating the products or in deoxygenating the gasoline.

The initial $1,000,000 research and development program carried on by Hydrocarbon Research was financed by three companies: the LaGloria Corp., the J. S. Abercrombie Co., and the Socony Vacuum Oil Co., Inc. Later material development and engineering contributions were made by the Standard Oil Co. of New Jersey and by The Texas Co. The country as a whole should recognize the role these companies have played in furthering the development of cheap synthetic gasoline in the U. S.

P. C. Keith (left), author of the accompanying article describing the new Hydrocol Process, was active during the recent war as technical director of the atomic bomb gaseous diffusion plant at Oak Ridge, Tenn. He is shown receiving the Medal for Merit from Secretary of War Robert P. Patterson for his work in that field. Mr. Keith is now president of Hydrocarbon Research, Inc., which developed the Hydrocol Process to its present stage. He has long been active in the design and construction of petroleum industry plants and facilities

Significance to Industry

The successful operation of the plant at Brownsville could have farreaching effects upon our national economy. These effects are most likely to be first felt in the oil industry. The feasibility of producing large quantities of a superior motor fuel from a portion of our "known" dry gas reserves will have been demonstrated. Since these reserves amount to about 175 trillion cu. ft., potentially they represent about as much oil as do our crude oil reserves. In other words, when the Brownsville plant has operated successfully and economically over a period of time, it would then be proper to reckon our oil reserves at, say, 40 billion barrels, rather than at 20-odd billion barrels. Then natural gas will begin to compete with crude oil as a raw material from which to produce refined products. What effect this competition will have upon advancing crude oil prices is anybody's guess. Mine is that it will put a ceiling of less than $2 per barrel on crude oil.

An obvious corollary to the above has to do with gas conservation. Sometimes it is difficult to legislate conservation, but when conservation is clearly and immediately profitable, no legislation is needed. Despite the conservation measures now enforced by various state-regulatory bodies, gas wastage still amounts to about 600 billion cu. ft. per year. The major source of this loss occurs in gas vented from oil-gas separators at the fields and from natural gasoline plants. The successful operation of the Brownsville plant will place a portion of this gas in the category of a substitute for crude oil. If it were all used for such a purpose, some 60 million barrels per year of oil would result. The problem of collecting the gas in large quantities will prevent the use of the entire amount, but some of it will be used, and to the extent it is used true and real conservation will have been practiced.

Further, the Brownsville plant will indicate a method whereby gas now used as refinery fuel can be converted into gasoline. Again, if all such gas were used for gasoline synthesis, the amount produced would approximate 7½% of our 1945 production. Obviously, all will never be so used, but some refineries will use it, substituting heavy bunkering oil for gas as refinery fuel. And this will lead to an advance in oil prices.

So much for the immediately foreseeable effects upon the oil industry. But how does this development directly and indirectly affect the gas industry? The effects could be fundamental and far-reaching. Firstly, the competition of natural gas with crude as a source of gasoline is certain to increase the price of gas at the well head. In the next several years, improvements in the Hydrocol process will make possible the production of a barrel of oil from 8000 cu ft of gas, including all gas used for fuel. If at that time the capital and operating cost of a Hydrocol plant is on a par with an oil refinery (and there is no basic reason why this cannot become true), then 8000 cu. ft. of gas at the re-

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finery will be the equivalent of a barrel of 38° API gravity Mid-Continent crude. Then, under these conditions, gas at 17 cts. per 1000 cu. ft. just balances crude oil at $1.35/bbl.; both prices as delivered to the refinery.

It is my guess that gas in such localities as Hugoton, East Texas and the Gulf Coast will never quite reach the equivalent price of crude oil. In the first place, gas transportation is inherently more expensive than the transportation of crude oil. Secondly, gas must always be transported by gas pipe lines and not by tankers or tank cars. Therefore its mobility is limited. Thirdly, the effect which the actuality of cheap oxygen will have upon manufactured gas costs will tend to limit the competitive value of natural gas for pipe lines. Nevertheless, gas prices will go up. It is not unlikely that, in the localities I have just mentioned, gas at the well head will be worth 10-12 cts. per 1000 cu. ft. within the next decade.

This increase in gas price will affect various pipe line companies differently. Those producing more gas than they buy will benefit. Those buying more than they produce may suffer temporarily. I use the word "temporarily," for once natural gas is competitive with crude oil as a source of gasoline, a price floor is established for gas to pipe lines. I should think that any rate-making body would logically base its calculations upon this competitive and possibly posted price of natural gas, rather than upon the present assumption that a gas well is an integral part of a pipe line system. If gas rates are raised in step with the competitive price set by the price of crude then, with an increasing gas price, the pipe line companies, at worst, will suffer only until the corresponding rate adjustments are made. In any event, it would seem wise for the pipe line companies to endeavor to secure adequate gas holdings and reserves.

I have said that cheap oxygen will tend to limit the price of natural gas in such localities as Kansas and Texas. You will recall that the Germans completely gasified "Braunkohle" continuously, successfully and economically. It appears that improvements, comparable in magnitude to those made in the Fischer-Tropsch process, can be made in the gasification of coal.

It has long been the ambition of the manufactured gas industry to produce city gas directly from coal and oxygen. Compared with the present intermittent methods, the direct gasification process would be more thermally efficient, would eliminate the use of expensive gas oil and could be continuous. Hydrocarbon Research, Inc. has such a process in an advanced stage of development. A small pilot plant has been built and successfully operated in which both coking and non-coking coals are distilled and partially gasified with oxygen. The gas as run from the pilot plant has had calorific values higher than required for city gas. Freed of carbon dioxide, the heating value of the gas has varied from 580 to 900 BTU per cu. ft. according to the extent of gasification of the coal.

Based upon these preliminary data and again applying advanced oil refinery techniques to the process design, "guesstimates" have been made which indicate that in such localities as New York, city gas can be made from bituminous coal at a cost less than the cost of natural gas purchased at the wells in Texas for 5 cents per 1000 cu. ft. and transported to the east coast by pipe line. Also, the estimated cost of gas by the direct gasification process is much lower than the present cost of gas manufactured by the larger utility companies.

These studies posed the further question, "Why haul coal to New York and then gasify it?" "Why not gasify it at the mine mouth?" Hence, a careful, thorough, and intensive survey was made of all German processes. These were evaluated in the light of the data gathered from Hydrocarbon's own experimental work. Then a hypothetical plant was designed. From this preliminary work, it appears certain that eventually a process will be developed whereby either coking or non-coking bituminous or anthracite coal can be completely gasified, yielding a pipe line gas of approximately 1000 BTU heating value. These preliminary studies further indicate that the net thermal efficiency—i.e., the ratio of the heating value of the product to the heating value of the coal, including all coal used as fuel—will be about 80%. In other words, it is to be expected that one ton of 13,000 BTU/lb. coal will yield 20,000 cu. ft. of synthetic natural gas.

Hydrocarbon Research is presently building a semi-commercial plant to produce directly, continuously and with oxygen both "city gas" and "pipe line" gas. It is hoped the plant will be in operation this year and that quantitative design data will be available next year. Our expectations for the process are based in part upon the data gathered during the course of development of the Hydrocol process. If they are realized, one can visualize gas pipe line companies serving the north and the northeast manufacturing "synthetic" natural gas from coal mined in West Virginia, Illinois and Pennsylvania. Obviously, this development of the direct gasification process will tend to place a ceiling on the price of natural gas.

We have now seen how the Hydrocol process is likely to affect both the price of crude oil and the price of natural gas, placing a ceiling over the former and raising the latter. We have also seen how the development of a direct gasification process will tend to place a ceiling over the price of both natural gas and manufactured gas. A further factor to be reckoned with in our future economy is the approaching coal-to-gasoline process. An economic process for transforming coal into gasoline will put a ceiling over the price of crude oil even more effectively than the Hydrocol process. Also, it may well increase the value of some of our low grade coal deposits. However, the amount of coal required to satisfy our entire gasoline market will always be small in comparison to the coal used for other purposes, and so the effect on the country's coal economy as a whole can never be great.

I said "approaching coal-to-gasoline process," for we are now well on our way to gasifying coal cheaply, and the combination of the direct gasification process and the Hydrocol process *is* the coal-to-gasoline process. In fact, on the basis of figures now available, 6 cts. gasoline from $2 per ton coal is not more than two or three years off.

In summary, the successful development of the processes just reviewed will (1) assure this country an adequate supply of cheap gasoline, city gas and petroleum products for centuries to come; (2) make available cheap oxygen for use in the chemical and metallurgical industries as well as in the gasoline and gas industries; and (3) provide cheap raw materials, particularly carbon monoxide, hydrogen and oxygenated hydrocarbons, to serve as the basis of a great new synthetic chemicals industry.

Oil Companies Participate in Hydrocol Process Plant

Eight oil and gas and allied companies are participating in the financing of Carthage Hydrocol, Inc., which will build and operate the plant at Brownsville, Texas, for converting natural gas into gasoline and other liquid products by the Hydrocol process. A $9,000,000 government loan has also been authorized by the Reconstruction Finance Corp.

Contributing to its nearly $10,000,000 capital stock are the following companies: The Texas Co., $3,778,125; Forest Oil Corp., $1,259,375; Niagara Share Corp., $1,259,375; United Gas Corp., $1,007,500; LaGloria Corp., $1,007,500; Gulf States Oil Co., $377,812; Stone & Webster Inc., $377,812; The Chicago Corp., $503,750.

The Texas Co., largest stockholder is to have first consideration as a purchaser of the plant's products, it is stated. Construction of the Brownsville plant will be under the direction of Hydrocarbon Research Inc., of which P. C. Keith is president.

Chemicals Present in Escaping Wastes Can Damage Waters for Many Uses

Article 7 in a Series—*By W. B. Hart*

In charge of Waste Disposal for Atlantic Refining Co.

Chemicals frequently found with the oil in refinery wastes may react with other chemcial substances present in clean waters to adversely affect the use of such waters. By changing the pH value of the water they may make it necessary to install expensive pH control and treating methods for water for both industrial and domestic use. Aquatic life also may be affected.

Acids present in refinery wastes may lead to the corrosion and deterioration of steel, concrete and even wooden structures. They may have a definite effect upon the recreational uses of the waters.

Alkalinity in refinery wastes, as contributed by soda ash and caustic soda, if discharged in quantities, may also have harmful effects on surface waters. Emulsions of oil and water in wastes break up easily when introduced into surface waters and have the same effect as free oil.

EARLIER in these articles it was mentioned that there are two major types of emulsions in refinery wastes, water-in-oil and oil-in-water. If either of these escapes to surface waters, serious damages may result.

Water-in-oil emulsions usually occur in masses, although sometimes an entire tank bottom will consist of a continuous, liver-like mass of emulsion of this type and will flow without breaking up. But when such an emulsion finds its way to surface waters, wind and wave action, or agitation resulting from turbulent flow, cause it to break into discontinuous masses.

These emulsions are cellular in their physical makeup. The greater part of the total mass usually is oil and, since the oil may be either lighter or heavier than water, the emulsions may float or sink. Those which are heavier than water usually are formed at elevated temperatures and, at these temperatures, may actually have a density less than that of water because of the high coefficient of expansion of oil. However, when they are cooled to the temperature of the surface water, the oil contracts, its density becomes greater than the density of water, and the emulsion sinks.

Water-in-oil emulsions are bound by a septum which often is stabilized by finely divided particles of solids. It might be thought that this septum would retain the oil, and that floating emulsions of this type would not coat with oil the surfaces of plants, animals or structures with which they come into contact. Experience does not confirm this. The so-called cells are relatively small, and the septum can be ruptured quite readily. Consequently, when floating emulsions of this type are carried against other than very smooth surfaces the septum is ruptured, water and free oil are released, and the general effects of the emulsion on the surface waters, on structures, and on aquatic life, are the same as those of free oil. The ease with which the release of oil and water can be brought about may be demonstrated by rubbing some of the emulsion very gently between the fingers.

Emulsions of this type will be broken by contract with soil and the oil released will penetrate the ground. Its effects will be, of course, those of free oil.

Water-in-oil emulsions may sink to the bottom of the surface waters as soon as they are introduced. Many of them float, however, and are subject to the agitation of the waters, the rupturing effects of contacts with vegetation or structures, or the molar action of very shallow water near the shore. Since most emulsions of this kind do break rather easily, these forces release the oil, which then forms a layer or film on the water surface. This oil has the same effects as other free oil, and the mechanics of its final destruction are the same as those of the disappearance of free oil, described in the previous issue (June 5, 1946, p. R-467).

The effects of oil-in-water emulsions differ from those of water-in-oil types only in the mechanics through which these effects occur. As described under "Kinds of Refinery Wastes" the oil-in-water emulsions are the "milk-water" or "white-water" wastes, in which minute globules of oil are dispersed in the waste water. The oil content of such emulsions is relatively low.

The oil globules in emulsions of this type are held in suspension in two ways —by negative electrical charges on the surface of the globules, the true hydrosols, or by resistant, protecting films which surround the globules. Although either of these stabilizing influences may exist in the emulsion, it usually will resist agitation or contact with vegetation, stream banks or bottom, or structures. Then, oily marks or layers may be left after contact, but it is difficult to be sure whether these oil marks are made by oil in the emulsified form, oil freed by the contact, or oil which has broken out of the emulsion before contact has been made. Thus, if contact with oil-in-water emulsions is constant, i.e., if the pollution is continuous, the effects are quite pronounced.

The most severe effect of oil emulsified in this manner is that on aquatic animals. Dissolved oxygen is consumed by bacteria which in their metabolic processes oxidize the oil. Animals which take water through various body pores, or channels, are killed by asphyxiation, for the oil is separated from the emulsion in the process and coats the involved tissues. This prevents gaseous interchange. Small unicellular or polycellular animals which absorb oxygen directly into the cells[78] are highly susceptible. Fish pass water through the mouth, over the gills, and out through the gill openings[86, 87]. The gills are delicate and highly important structures by which the fish breathe. They are almost fringe-like in their make-up and carry numerous blood vessels. As milk-water emulsions pass through the fringe-like structures the oil is separated and this coats and mats them. The fish soon die. This has been

demonstrated in both the laboratory and in the field.

Almost as soon as this type of emulsion enters the surface water it tends to diffuse and mix with all the water. As it does so, either the electrical charges are neutralized, or the film surrounding the globules is precipitated by heavy cations in the water, depending upon which of the two conditions has stabilized the emulsion. In either event the oil is released and comes to the surface. Usually this oil is dark and heavy. Often it is shot through with white soap-like streaks. It is viscous and inclined to attach itself in patches to any surface which it contacts. It takes a rather long time to film to an extent which will be subject to disruption into patches and result in sinking. In general, however, its effects are the same as those of free oil.

Effects of Chemicals in Wastes

Whereas oil is a substance which is foreign to and immiscible with the surface waters, wastes which influence the hydrogen-ion concentration, the acidity, or the alkalinity of the surface waters usually are solutions or suspensions of chemicals. These chemical substances enter into reactions with other chemical substances normally present in clean surface waters. In so doing they change the character of the dissolved matter in the waters and if the change is sufficiently great, it will adversely affect the uses of the waters, also the aquatic life in these waters.

Hydrogen-Ion Concentration

Hydrogen-ion concentration in general is a measure of the intensity of acidity or alkalinity of solutions such as surface waters. It has been defined earlier as the reciprocal of the logarithm of the normality of the hydrogen-ion in the solution. A normal solution is one in which the weight in grams of substance dissolved in one liter is equal to the equivalent or combining weight of the substance. Thus, theoretically for the hydrogen ion H^+ this weight will be 1.008 grams (O=16) per liter, and the pH of such a solution is 0.0.

Similarly, a solution containing 17.008 grams of hydroxyl ions (OH^-) will be a normal solution with respect to that ion. The pH at this concentration has been set at 14.0. When both hydrogen and hydroxyl ions are present in the surface water, which is the condition always, the pH could range from 0.0 to 14.0. When these ions are present in equal concentration the condition in general is regarded as neutrality, and the pH value is 7.0; pH values below 7.0 indicate acidity and those above 7.0 indicate alkalinity with respect to intensity[47,88].

With this understanding of the meaning of hydrogen-ion concentration, consideration can be given the effects of refinery wastes on this characteristic of surface waters (i.e., the pH). As stated previously, the pH of surface waters ranges from about 3.0 to 10.5. There are moderately rare instances of values somewhat below and somewhat above this range but they are of little or no importance here. The majority of the clean waters over the country will fall within a much narrower range of from pH 6.0 to pH 8.5. This means that in this majority of clean waters, which includes all the important rivers and lakes upon which most petroleum refineries are located, the hydrogen ions and the hydroxyl ions are nearly in balance. In general, this is the natural condition with which untreated refinery wastes can interfere.

It can be demonstrated by analyses taken at intervals over relatively long periods of time that this balance between hydrogen and hydroxyl ions is quite closely maintained. That is, it is practically constant in a given body of surface water, and may be regarded as characteristic of that body of water. This is a matter of great importance to the waste treatment and disposal practices of any given refinery.

The balance between the hydrogen and the hydroxyl ions is maintained by the interaction of chemical substances dissolved in the water, and carbon dioxide absorbed from the atmosphere or resulting from the respiration of animals and plants. The mechanics of this balance are rather complex, but for the purpose of this discussion the following brief explanation will be sufficient:

Most of the dissolved mineral matter in clean surface waters consists of the bicarbonates of calcium and magnesium. These bicarbonates will react with either acidic or alkaline substances. When carbonic acid (H_2CO_3) reacts with calcium bicarbonate ($Ca(HCO_3)_2$), for example, normal calcium carbonate ($CaCO_3$), water, and carbon dioxide (CO_2) result. Normal calcium carbonate is insoluble and settles to the bottom so that, if the above reaction continued unchecked, with carbonic acid continually present to react, all calcium soon would be removed from solution.

But the water absorbs carbon dioxide only until there is equilibrium between the pressure of the gas in solution and that in the atmosphere above it, and this results in only a low concentration in the water. Only a little over half of the carbon dioxide absorbed is converted to carbonic acid, and this acid reacts with calcium carbonate to form calcium bicarbonate. In these reactions is found the mechanics of the balance by which surface waters maintain a relatively uniform pH value. The relationship between carbon dioxide (carbonic acid), bicarbonates, and normal carbonates, all expressed in terms of equivalent calcium carbonate, is well illustrated by Moore and Dye[89].

But when mineral acids such as sulfuric acid, or alkalies such as sodium carbonate or hydroxide enter the surface waters, reactions take place which are not reversible, and the whole character of the waters is changed. The waters at first attempt to preserve their normal pH by buffer action. Bicarbonates react with the acid or carbonic acid reacts with normal carbonates which in turn react with the acid, until all bicarbones or all carbonic acid, which cannot be absorbed rapidly, are gone. Mean-

COMPULSORY WASTE DISPOSAL CALLED FOR IN BILLS NOW BEFORE CONGRESS

Bills in both the Senate and House call for comprehensive programs under the direction of the Surgeon General to abate and prevent the pollution of streams by sewage and industrial waste. A report from the Committee on Rivers and Harbors of the House says that, in spite of many purification and treating plants having been built, the volume of untreated waste is greater than ever before. It terms the present condition an emergency matter.

The bills ask Congress to consent to compacts of states to undertake joint anti-pollution measures. Loans to both municipalities and private industries would be authorized to build treating plants.

Regulations establishing standards of cleanliness for navigable streams, by sanitary districts, and prescribing methods for treating wastes before their discharge into such waters, directly or indirectly, would be drawn up by the Surgeon General, the House bill provides. Court proceedings could be brought to prevent or abate violation of these regulations. Industries would be given two years to provide treating or disposal plants before court actions could be brought. The Senate bill provides only for recommendations of the Surgeon General as to remedial measures.

The House bill is H.R. 6024, "relating to the prevention and control of water pollution"; the Senate bill is S 1462, "to provide for water-pollution-control activities in the U. S. Public Health Service". In the discussions on the bills it was brought out that 38 states in 1945 either passed new anti-stream pollution laws or strengthened their old laws.

while the pH falls or rises, but not rapidly. But when all these buffering substances have been reacted the change in pH is rapid, falling if the waste contains acids, and rising if it contains normal carbonates and hydroxides or either of these alone. At about pH 4.3 all bicarbonates will have been destroyed, and mineral acidity will control the pH at all lower values. At about pH 10.0 all bicarbonate will have been converted to normal carbonate, and the concentration of hydroxyl ions will dominate all values above.

The effects of refinery wastes upon the hydrogen-ion concentration of surface waters are accompanied by resulting effects on the uses of the waters and on the life in them. The pH of its water supply is important to any industry. Often the quality of water available greatly influences the selection of a plant site, and also its processing. A desirable and uniform pH value has large part in such decisions. Then, if through the disposal of wastes the pH is depressed or elevated considerably, it may be necessary to install expensive pH control methods and treatment processes. Boiler water treatment is very susceptible to a change in pH value of the water supply. Water purification plants for domestic supply which use flocculation as a part of their treatment may be affected very seriously, for efficient flocculation usually depends upon close control of pH. This will be difficult and expensive to maintain, if wastes cause considerable and fluctuating pH change. Even in plants which do not use flocculation there may be difficulty and expense for correction of pH values to produce an acceptable quality of water.

Influence of pH on Aquatic Life

The influence of hydrogen-ion concentration upon aquatic life is a relatively confused matter. There can be little question that the pH value in an aquatic environment is important, but there is no clear explanation of why this is so. There is clear understanding of the value of optimum pH in culture media, for example, under conditions which are controlled. This has been established experimentally. But in surface waters the variety of conditions which establish the pH level, the complex environmental system in which it is effective, and the even greater complexity of the living organisms and the substances which it affects, make it extremely difficult to evaluate either the general effects of pH or how it affects any particular animal or plant[40,47].

Some years ago many investigators advanced the theory that pH is the most important of all the ecological factors operative in the aquatic environment. This theory recently has fallen into disrepute, for there is no conclusive evidence that any one of all the complex factors of such an environment is of paramount importance. But pH still is regarded as having a position of some importance and certainly warrants further study and consideration. It may be important in either of two ways, first as an index of general environmental conditions, and second, as a factor limiting existence.

Probably as a result of the nearly uniform pH values which reasonably can be anticipated in a particular body of water, reasonable constancy of composition also may be expected in the communities of animals and plants which inhabit the various ecological regions of the water (i.e., shore areas, deep water areas, and so forth). Since the pH of most of the waters of the country falls within a relatively narrow range, many of these animals and plants are widely distributed. Some are restricted in distribution because of other factors such as temperature, turbidity, and so forth. But other forms are found in environments in which the pH falls outside the relatively narrow range of most waters even though other factors do not vary appreciably. All forms, however, are present in their respective environments because to them it is a desirable one. It may not be the optimum, but in it they thrive. The pH becomes to them an index of desirable conditions to which they become acclimatized.

Investigations show that pH definitely is an index of aquatic environment. By proper determination of pH there can be obtained indirectly information about the carbon dioxide content, alkalinity, dissolved oxygen, dissolved solids, and other conditions. Thus, a change of pH indicates a change in the environment as a whole. If the change is sufficiently great, forms important to the cleanliness of the stream may be driven away or destroyed. This may be due to the effect of the change in pH itself, or to the environmental changes it indicates. The ultimate result, however, is that any disposal to surface waters of waste which causes appreciable change in the pH of the waters, may adversely affect the life forms in the waters in serious degree.

In so far as change in pH alone is concerned, no really critical effects have been demonstrated clearly. The effects it produces differ with different forms of tissue or organs. It is assured, moreover, that different organisms react in various ways to differences in pH levels.

As an example of one effect of difference in pH levels the reaction of strong acids (containing hydrogen-ions in high concentration) on protoplasm, as compared with weak acids (low hydrogen-ion concentration) may be considered. A 3% solution of sulfuric acid will severely irritate and "burn" delicate animal tissues, whereas a 3% solution of boric acid is used to bathe similar tissues, and 3% acetic acid is used in foods.

Various reasons have been advanced to explain this difference in reaction to pH. Among these are the theories that it may be due to some modification of the permeability of the cell membranes, or that it influences the ability of cells to absorb oxygen and give off carbon dioxide. It is difficult to determine the exact mechanics of the effects of pH for there always is confusion as to whether any effect is attributable to pH, to the anions in solution, or to the undissociated molecules.

Each organism has a maximum and minimum pH which defines a range of tolerance outside of which the organism will succumb. At some point within this range lies the most favorable or optimum pH. Some plants exhibit an additional zone within the range, in which the pH effect definitely is injurious. Little is known of this phenomenon with respect to animals, but Elliott[90] has established the effect with *Copidium*. General knowledge of the effects of pH indicates, however, that the range of tolerance tends to be wide [91, 92].

pH Also Affects Bacteria

There has been extensive investigation of the effects of pH on bacteria which, among other results, reveals that while some forms tolerate a quite wide range of pH, others are adversely affected outside of a relatively narrow range[93]. Various invertebrate animal forms exhibit practically the same reaction. The effect of pH on respiration and other systemic activities of some invertebrates has been studied and a general conclusion has been drawn that at higher concentrations of hydrogen ions all important activities are reduced in rate[91, 94].

Fish react variously to different levels of pH, but with respect to variation of pH alone (i.e., other conditions relatively unchanged) these animals also tolerate rather wide ranges. Brown and Jewel[95] as well as Wiebe[96] report experimental findings. Shelford[97] found that with few exceptions there is definite response to pH changes. This has been confirmed by others. Brown and Jewel found one important reaction, i.e., that in a gradient tank with water of pH 6.4 at one end and water of pH 8.6 at the other, various fish selected that level of pH to which they had been accustomed.

It will be clear from what has been presented that knowledge as to the effects of hydrogen-ion concentration is inadequate and confused. Two facts stand out, however. All life forms tend to remain in waters having a pH level which is practically constant and to which they are accustomed. They will react to change in pH by leaving waters in which this factor is undesirable to them. Secondly, pH can be regarded as an index of environment and of changes in other environmental factors. Therefore, the introduction into surface waters of any substance which changes the pH of these waters in any considerable degree must be given careful study, for changes in other important environmental conditions are indicated. Such changes can be and often are dam-

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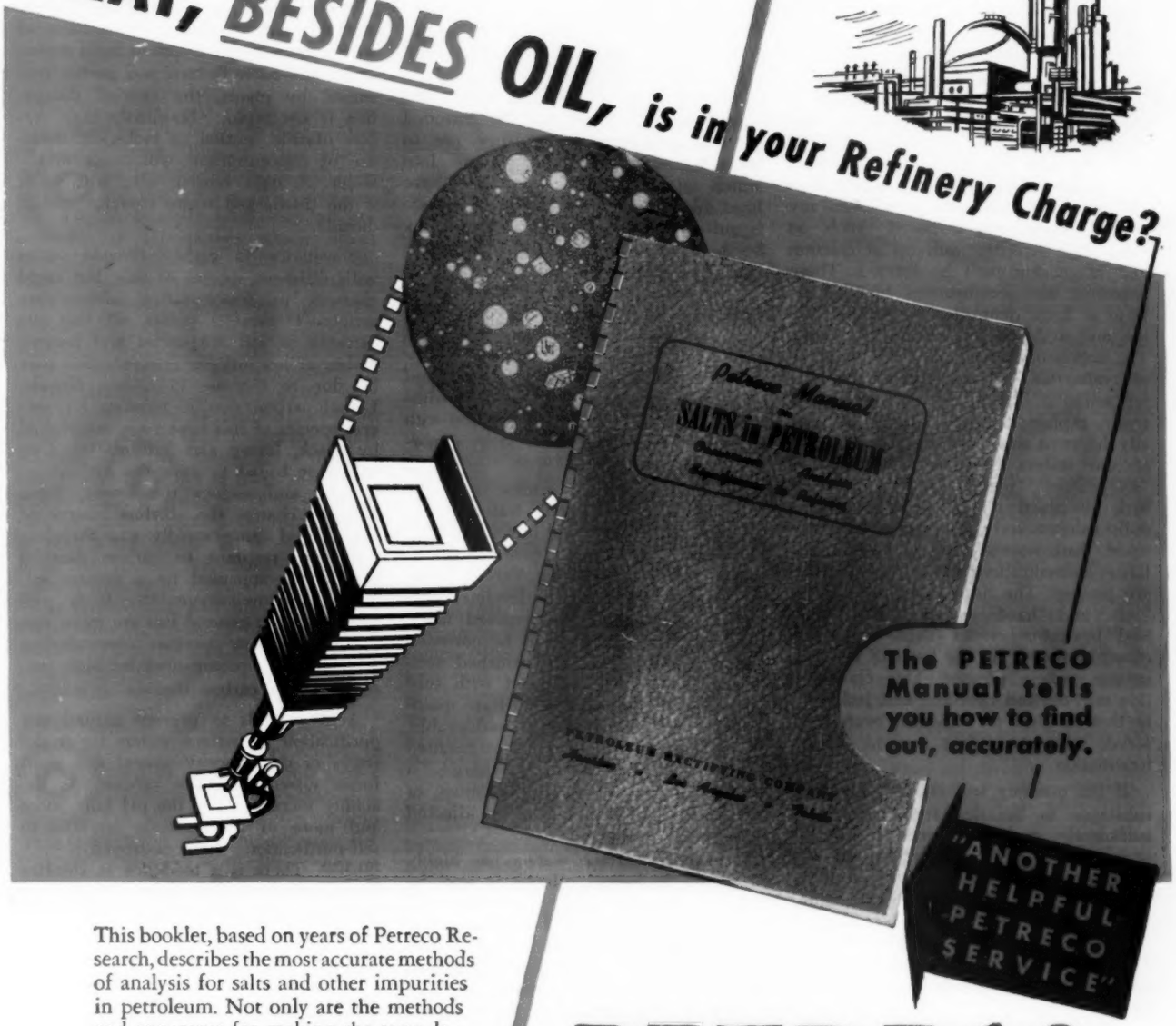
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aging to the surface waters and to the aquatic life they support.

Acidity

Acidity is a component of the wastes from a number of industries. The wastes from several petroleum refining operations normally contain free acid or substances of acid reaction, or both.

When an acidic waste is discharged into surface waters its first effect is to destroy their natural alkalinity. In doing so it causes a permanent change. For example, if a waste contains sulfuric acid, the acid will react with the bicarbonates of calcium and magnesium usually present in the waters, and with any normal carbonates exposed (such as marls and so forth). Sulfates of calcium and magnesium will be formed. These reactions are accompanied by the release of large quantities of carbon dioxide and a depression of the pH value. The action of the acid in depressing the pH value will be modified by the buffer action of the mineral matter, as already explained. Consequently, it usually happens that the effect on the pH of the waters is greater in so-called "soft-waters", which contain relatively little dissolved mineral matter (principally calcium and magnesium salts), than upon "hard-waters", in which relatively large concentrations of mineral matter are present. The differentiation between "soft" and "hard" waters will be clarified by reference to Table 1, which classifies waters on the basis of the carbonate radicle present. This classification was devised by Birge and Juday[98] in their studies of Wisconsin waters. It serves as a convenient method of differentiation.

If the quantity and intensity of acidic substance in the discharged waste are sufficiently great to destroy all buffer action of the surface waters the pH will be depressed at a relatively rapid rate. At about pH 4.3 actual mineral acidity will be present. The concentration of mineral acidity will depend, of course, upon the further addition of the waste containing the mineral acid (e.g., sulfuric).

The effects of acidity in surface waters are varied and complex. One of the most spectacular effects probably is corrosion. Usually, the lower the pH the more corrosive the water but this is not true always. Nor is it necessary that the pH be depressed to 4.3 (indicative of mineral acidity) before corrosive action becomes serious. As mentioned previously, acids or acid substances in discharged wastes release large quantities of carbon dioxide, some of which reacts with water to form carbonic acid. This also is highly corrosive.

Consequently, all steel, concrete and even wood structures will be corroded or will deteriorate when they are in contact continually with waters into which quantities of acidic wastes have been discharged. If the quantity of waste is sufficiently great, costly repairs may be necessary. Such waters cannot be used for many industrial purposes without treatment processes which often are expensive. In some instances treatment of any kind is impracticable. The purification of highly acid waters for domestic supplies is costly if practiced, and sometimes they cannot be purified without unreasonable cost in comparison with the cost of treating water from a normally clean supply.

The effect of high acidity upon the recreational uses of surface waters should be obvious. Even mild mineral acidity is irritating to delicate tissues such as those of the eyes and nose. Various forms of "rashes" sometimes develop after bathing. The paint and exposed metal parts of pleasure craft will be corroded and machinery may be damaged seriously. The acidity will react with substances in the stream bed to form quantities of salts which may be undesirable. If the acidity in the waters is augmented continuously by waste discharge, a stream may be of little use for miles, or a large area of a lake may be affected in a similar manner.

Acidity in surface waters has highly important biological effects. It may be pointed out that many bogwaters are of low pH value and yet they support a profuse biota (the animal and plant forms). The causes of the low pH in these waters, however, usually are their low mineral content and the presence of various organic acids which do not dissociate readily. This condition is not comparable with that resulting from the acid and acidic substances which normally are present in petroleum refinery wastes.

It was stated above that one of the first effects of acid waste is the release of large quantities of carbon dioxide. Although a part of this quantity is lost to the atmosphere more or less rapidly (through equilibration on the basis of partial pressures) depending upon turbulence and other factors, and part is consumed by plants, the over-all dissipation is not rapid. Abnormally high carbon dioxide tension (a biological measure of concentration) will occur in the water. A high tension also will result if the discharged waste contains carbon dioxide.

Sensitivity to carbon dioxide varies with different species of fish, but rapid changes in concentration always are serious. Powers[99] points out that the increase in red corpuscles and haemoglobin at low oxygen concentration may be due to increase in carbon dioxide. Lethal carbon dioxide tensions for several species of fish have been established by Black, Irving and Safford[100]. Catfish were found to have the highest resistance and suckers the lowest. Some fish can change the alkaline reserve of their blood quite rapidly and therefore are more resistant to carbon dioxide. This is accompanied by a greater tolerance of low oxygen[99]. It is well known that in general fish are more susceptible to low oxygen concentration when this is accompanied by high concentration of carbon dioxide.

Acidity tends to prevent natural self purification of surface waters for it destroys or drives away animal and plant forms essential to this process. As the acidity increases, and the pH falls, more and more of the bacteria essential to self-purification are destroyed[49,52,54,101,102]. There is a tendency to sterilize the waters. Some few forms survive[103] but they are ineffective. Control forms such as protozoa and zooplankton generally are driven away or are destroyed.

Acidity has a serious adverse effect on the plankton, particularly the microscopic green plants which contribute to the oxygen supply of the waters, and also on larger forms. In waters of low pH, i.e., highly acid, Purdy[101] found almost entire absence of phytoplankton (plant plankton forms) and but few ciliated protozoa. Larger forms were present but they consisted of but a few genera of Rotatoria. Free mineral acids apparently act directly and with lethal effect on the cells of minute plants, and protozoa seem to be affected in the same way, but they may leave acid waters because of the lack of bacteria to feed upon. These conditions alone will affect adversely all aspects of surface waters and many of their uses[101,102,104,105,106,107,108].

Fish are the most prominent of all aquatic life forms. They are affected by acidity in various and complex ways,

TABLE 1—Differentiation Between "Hard" and "Soft" Waters

Soft waters:—Contain small amounts of calcium and magnesium in solution, and bound carbon dioxide not in excess of 5 milliliters per liter (equivalent to approximately 10 p.p.m.)

Medium hard waters:—Bound carbon dioxide from 5 to 22 milliliters per liter (equivalent to approximately 10 to 44 p.p.m.)

Hard waters:—Bound carbon dioxide in excess of 22 milliliters per liter (equivalent to approximately 44 p.p.m.)

Note:—To convert from milliliters of carbon dioxide per liter to parts per million multiply by 1.997. To convert from carbon dioxide to calcium carbonate multiply by 2.27.

of which an important one is the effect on respiration. The amount of oxygen which fish can utilize per hour, per unit of weight, varies with the intensity of the acidity[109]. This, as noted above, can be correlated with the alkaline reserve of the blood[110]. An increase in the alkaline reserve increases the affinity of haemoglobin for oxygen, and thereby increases the ability to take up oxygen at low tensions. A decrease in the reserve has the opposite effect.

Finally, acids have toxic properties which may be due to either their acidity or to the anion. Ellis[111] has shown that lethality is characteristic of any mineral acid dilution with a pH value below 4.0. At this pH level they all are corrosive of the tissues which affect respiration. There are other toxic effects of acidity on fish which will be discussed under the heading of true toxicity.

Alkalinity

The alkalinity of refinery wastes usually is contributed by sodium carbonate (soda ash) and sodium hydroxide (caustic soda). The first effects upon the surface waters by either of these substances is the result of their reactions with the calcium and magnesium bicarbonates present in the waters. In these reactions both the sodium bicarbonate and the sodium hydroxide are converted to sodium bicarbonate, and the calcium and magnesium bicarbonates to normal carbonates. These in turn are converted to bicarbonates through reaction with carbonic acid.

This series of reactions constitutes the buffer effect of the surface waters to alkalinity, and as a result of this buffer effect the hydrogen ion concentration is changed but slightly until the calcium and magnesium bicarbonates and the carbonic acid content of the waters is materially reduced. Bicarbonate elimination is practically complete at pH of approximately 10.

The effect of alkalinity on the uses of surface waters is not so serious so long as the hydrogen-ion concentration does not exceed about pH 10, and for some uses is not too serious even somewhat above that level. Below pH 10 the water for only critical industrial uses will require correctional treatment. Such waters from sources otherwise clean are usable for domestic supply after relatively simple treatment, and for some "softening" processes the comparatively high pH may prove to be advantageous. Even for recreational purposes this degree of alkalinity will not be objectionable except for possible biological effects as noted below.

But if alkaline wastes are discharged into surface waters in quantities which raise the pH above about 10, more serious effects follow. Waters of such high alkalinity approach causticity and cannot be used for a number of industrial purposes unless they first are subjected to treatment processes which may be costly.

Recreational uses are increasingly interfered with as the alkalinity increases. The effect of such water on the skin may prevent its use for bathing. The paint and other parts of pleasure craft will be attacked. At the higher pH levels concrete and wooden structural work will be affected adversely.

The effect of alkalinity on aquatic life is related principally to change in environmental conditions at pH levels below 10. As stated previously, aquatic life forms are prone to leave the waters when a change in environmental conditions of even relatively low magnitude occurs, and to seek conditions to which they have become accustomed. Bacteria, zooplankton, various higher invertebrates, and the vertebrates (fish, amphibians, and so forth) all react to any considerable change in this manner even though by remaining they may become acclimatized to the new conditions.

When the alkalinity introduced into the surface water is so intense, and in quantity is so great that the buffer effect of the waters is overcome, the pH will rise to above 10 and approach 14. Under these conditions there will be actual damage to aquatic life forms, even though both plants and animals tolerate rather wide ranges of lower values of pH, and even though the rate of penetration of the hydroxyl ion is comparatively slow. Both corrosive and toxic effects result. The cells of bacteria and microscopic plants and animals which aid in stream self-purification are destroyed; the cells of larger plant forms are broken down; the gills of fish become coated with coagulated mucus and the fish die. Only a few very hardy life forms can survive conditions of alkalinity corresponding to the highest levels of pH.

In the August issue, the effects of refinery wastes having other characteristics will be discussed. This will conclude the groundwork necessary to the full understanding of the descriptions of various organization and waste treatment methods to follow.

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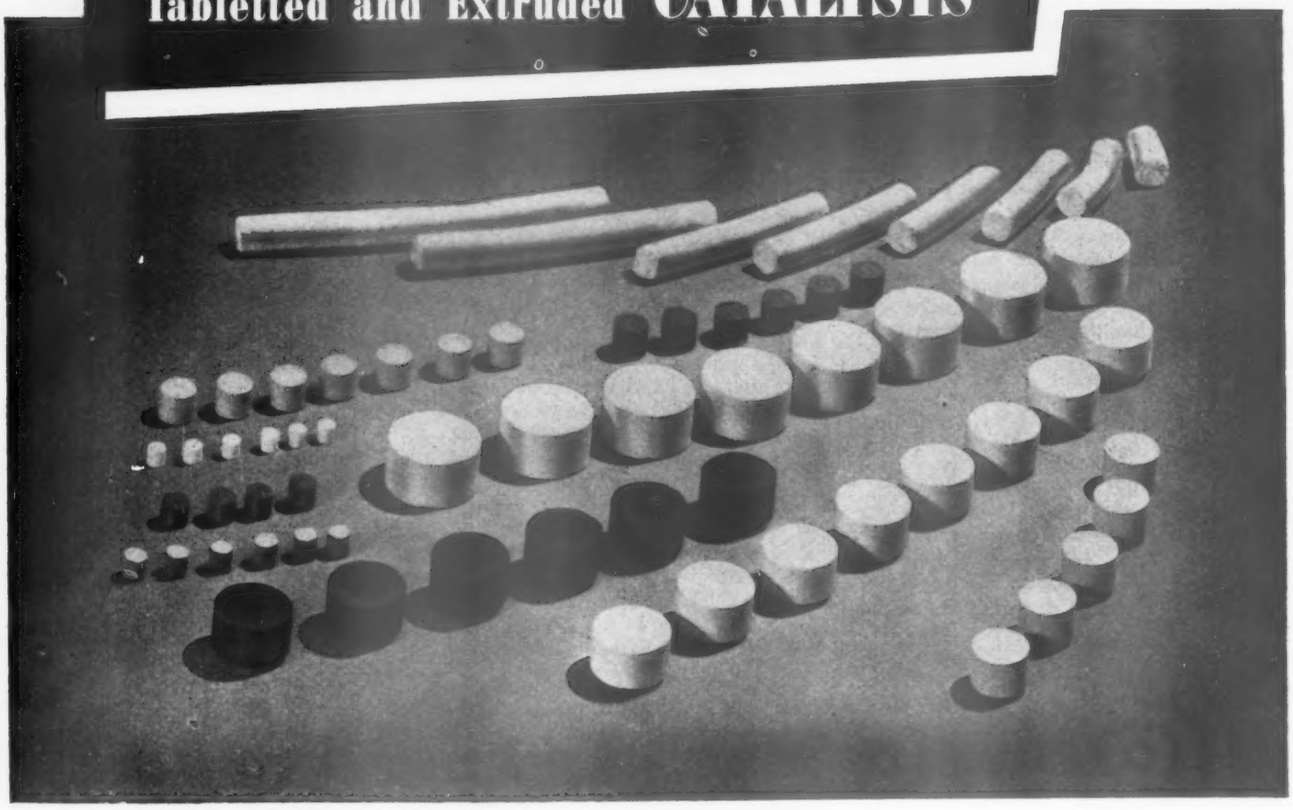

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Analyze Additive Lubricants In Minutes Instead of Hours With Spectrographic Method

By Lyle E. Calkins and M. M. White

Control laboratories sometimes lag far behind production when the time-consuming conventional methods are used for the chemical analysis of additive materials and additive lubricants which are in such widespread use today.

To overcome this difficulty, an automotive company's laboratory has developed a technique for spectrographic analysis using the internal standard method, by which quantitative analyses could be made in a matter of minutes. Hours are required when using the usual chemical procedures.

This technique has been applied to phosphorous, calcium, barium, zinc and lead in lubricating oils or lubricating oil additives. It is believed that other metallic elements can be analyzed by the same methods and that this new spectrographic technique may be applied to materials other than oils, so as to increase the scope and efficiency of the control chemist.

A method of chemical analysis of metals and phosphorous in lubricating oil was also developed. It is faster than conventional methods, but just as accurate.

THE research chemist and the lubricating engineer have made great strides in preparing and formulating additives which will improve specific properties of a lubricating oil. They have advanced this science to a point where lubricants are practically prescribed as a doctor prescribes medicine. These additive oils have been enthusiastically received by the consumers, and the major lubricating oil producers tell us that they are here to stay.

Hundreds of metallo-organic substances have been invented and patented for the improvement of specific properties, such as lubricity or oiliness, extreme pressure, pour point, detergency, anti-oxidation, anti-corrosion, viscosity index, and heat resistance in all types of lubricating oils. These additives are incorporated in the lubricants in relatively small quantities. In order to keep the lubricants uniform, some measure of control is imperative, which in turn requires methods for the analysis of these complicated additive materials.

It is the purpose of this paper to give a description of some faster methods of chemical analysis and a detailed description of the spectrographic analysis of additives, additive lubricants and gasolines. These methods have been worked out with the intention of increasing speed and accuracy. By the spectrographic technique, control analysis may be made on additives or additive oils in a few minutes, as compared to 12 or 16 hours for an analysis by chemical methods.

The additives which interested us the most were those which contained phosphorus and/or metallic elements, because such types are used in motor oils. These elements are generally present in definite percentages according to the number of atoms of the element in the molecule of the additive compound. For example, if the additive contained 1.0% barium, the total additive concentration would be 100 times the barium content. The same would apply for phosphorus and other metallic elements such as calcium, zinc, sodium, lead, tin, copper, iron, aluminum and nickel.

A.S.T.M. Methods D-811-44T and D-809-44T for metals and phosphorus in lubricating oils are tedious, difficult and time consuming. Also there are inherent errors in ashing the lubricant. Since we had spectrographic equipment available, we attempted to use it for oil analysis.

We talked with chemists of several oil companies who have been interested in the spectrographic analysis of oils for phosphorus, barium, etc. The methods they have studied fall into two classes: first, those in which the oil was sprayed into the analytical gap; second, those in which either the oil itself or an oil sample that had been ashed was placed in the hollow crater of a carbon electrode. To the best of our knowledge, these methods were quite disappointing.

On Nov. 6, 1945, Mr. Lyle Calkins presented a paper on "Performance Characteristics of Detergent Motor Oils Versus Non-Detergent Motor Oils", at a meeting of the Society of Automotive Engineers in Tulsa. For this paper it was found desirable to determine the percentage of phosphorus, zinc, and cal-

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Lyle E. Calkins, left, is Chief Chemist at Willys-Overland Motors, Inc., Toledo, Ohio. Prior to joining Willys in 1943 he was chief chemist at Libbey Glass Co., and earlier held the same position with Liquid Cooled Engine Division of American Aviation. Mr. Calkins is author of the paper "Performance Characteristics of Detergent Motor Oils Versus Non-Detergent Motor Oils," presented at the S.A.E. National Fuels and Lubricants meeting last November. He is a member of the American Chemical Society, American Society of Metals, and Society of Automotive Engineers, and has been active on S.A.E. lubricant committees.

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cium in several samples of motor oils. Because of the late date at which these samples entered into the picture and the probability of not completing the chemical analyses in time, we made our first attempt to analyze these oils spectrographically.

After a few attempts we found that phosphorus and metals showed characteristic lines. Therefore we began to develop a method of spectrographic analysis of additive oils. It was necessary to get additives and analyze them chemically so as to prepare standards. Various manufacturers whose products are well known in the oil industry supplied us with the necessary additives and their approximate analyses. We then made our first chemical analyses according to the standard A.S.T.M. procedures.

Chemical Analysis

In order to speed up the analytical work we eliminated the ashing procedure and subsequent transfers. A brief description of the procedure used for the chemical analyses is as follows:

1. Weigh out 2.0000 grams of additive or 10.0000 grams of oil containing additive in a 600 ml. pyrex beaker.

2. Add 10-15 ml. of fuming sulfuric acid. Mix for several minutes and then place on hot plate until the sample is well charred.

3. Cool and add 10 ml. of concentrated nitric acid. Heat to boiling and make additions of 2 ml. concentrated nitric acid dropwise at intervals, until a clear carbon-free solution is obtained. This usually requires 3 or 4 additions of 2 ml. of concentrated nitric acid.

4. When a clear solution is obtained, boil off the nitric and sulfuric acids until the total volume is approximately 5 ml. (The time required up to this point is approximately 30 min.)

5. Cool and dilute with 100 ml. of distilled water. If barium is present, it will precipitate quantitatively as $BaSO_4$.

6. Filter off the $BaSO_4$ if present and proceed according to accepted analytical procedures for zinc, calcium, phosphorus, etc.

7. Determine zinc by precipitating ZnS in buffered acid solution with H_2S; oxidize the filtrate with bromine water, precipitate calcium as the oxalate in acid oxalate buffered solution; filter off the calcium oxalate and determine phosphorus in the filtrate. To determine phosphorus, evaporate the filtrate until it begins to crystallize. Remove from the hot plate and cool. To remove ammonium salts add 30 ml. concentrated nitric acid and heat gently. After the reaction ceases, evaporate almost to dryness. Then precipitate the phosphorus as $MgNH_4PO_4$ in ammonia solution with magnesia mixture. Filter and ignite to $Mg_2P_2O_7$.

The above method is typical for the chemical analysis of additives included in this paper. A good analytical chemist can run several complete additives or additive oils in 8 hours. With careful work accuracy of 0.02% is obtained. Of course the procedures will have to be modified for elements other than those mentioned.

For additives containing phosphorus and/or one metallic element such as barium, calcium, or zinc, the procedure is very simple. Good results are obtained by refluxing a weighed sample of 2-10 grams for 3 hours in 100 ml. of concentrated nitric acid. Precipitate barium, if present, as $BaSO_4$, zinc as ZnS, Ca as CaC_2O_4. There are indications that sulfur, lead and chlorine may also be determined by this procedure.

Description of Additives Used

Additive No. 1. This additive was a thiophosphoric alkylester, heavy-duty motor oil additive with oxidation and bearing corrosion inhibitors containing zinc, calcium, phosphorus and sulfur.

Additive No. 2 was a similar type heavy-duty motor oil additive containing barium, calcium, phosphorus and sulfur.

Additive No. 3 was a premium oil, medium duty type oxidation and bearing corrosion inhibitor, containing barium, phosphorus and sulfur.

Additive No. 4 was medium duty motor oil additive similar to No. 3 and contained barium, sodium, phosphorus and sulfur.

Additive No. 5 was also a medium duty motor oil additive containing calcium, zinc, sulfur and phosphorus.

Additive No. 6 was an anti-oxidant and bearing corrosion inhibitor containing phosphorus and sulfur.

Additive No. 7 was a commercial lead naphthenate.

Additive No. 8 was tetraethyl lead.

Table No. 1 will show the chemical analyses of the 7 lubricating oil additives, which were analyzed several times chemically until accuracy was assured.

These additives were used to make up standard solutions in oil, on a percentage by weight basis.

Standard solutions were made from Additive No. 1 by dissolving the additive in a 200 S.U.S. @ 100° F. neutral low viscosity index oil. Five standard solutions were made which contained the additive in oil. These standards are numbered one through five.

Standard solutions were made from Additive No. 3 in exactly the same oil and additive concentrations and are numbered 6 through 10.

A series of four standard solutions were made from Additive No. 6, using the same low viscosity index oil. These standards are numbered 11 through 14. Another series of ten standard solutions were made up, using the first five additives. Each additive was made up with approximately the same per cent by weight in a solvent-extracted 100 V.I. 419.2 S.U.S. @ 100° F. paraffin neutral oil and a solvent-extracted 100 V.I. 89 S.U.S. @ 100° F. paraffinic neutral oil. This was done in order to ascertain the effect of viscosity on the spectrographic method. These standards are numbered 15 through 24.

Two series of standard solutions of Additive No. 7, lead naphthenate, in oil were made up. The lead content was identical in each series. In one series the oil used was a 200 S.U.S. @ 100° F. low V.I. neutral. In the other series a 3000 S.U.S. @ 100° F. 90 V.I. oil was used. This was done to study the effect of extreme viscosity ranges on the spectrographic analysis of lead in oils. These standards are numbered 25 through 34.

To ascertain the feasibility of determining tetraethyl lead in gasoline by spectrographic analysis eight standard gasoline blends were made and analyzed carefully. Different base fuels, representative of typical gasolines, were used in making the blends. These standards are numbered 35 through 42. All the standard solutions and their additive compositions are given in Table 2.

Internal Standard Method

For the purposes of this article it will be assumed that the reader has a general knowledge of spectrographic analysis. However, it is of considerable interest to discuss in some detail the use of the internal standard method, which is the basis of most spectrographic analysis, in order to show why the spectrographic analysis of oils presents an unusual problem. The purpose of the internal standard method is to provide a check on the exposure conditions for every analysis, that is, the internal standard should indicate variations in exposure time, voltage changes, etc.

Let us illustrate briefly the use of the internal standard method in the spectrographic analysis of steel. A typical steel analysis might be as follows: C—0.23, Mn—0.82, P—0.03, S—0.02, Si—0.26, Mo—0.22, Fe—approximately 98.4%.

Note that the iron content is extremely high in comparison with any other element. For this reason an iron line is used as an internal standard for the analysis of steel. In the case of aluminum alloys, an aluminum line is used for the

TABLE 1—Chemical Analysis of the 7 Lubricating Oil Additives

Element	Additive No. 1	2	3	4	5	6	7
Ba	..	5.35	3.55	3.84	..	..	..
Ca	.88	.55	....	....	.52	....	....
Zn	1.05	..	..	..	1.87	..	..
P	.95	.58	1.70	2.86	1.70	5.0	..
Pb	....	....	....	....	....	....	30.6

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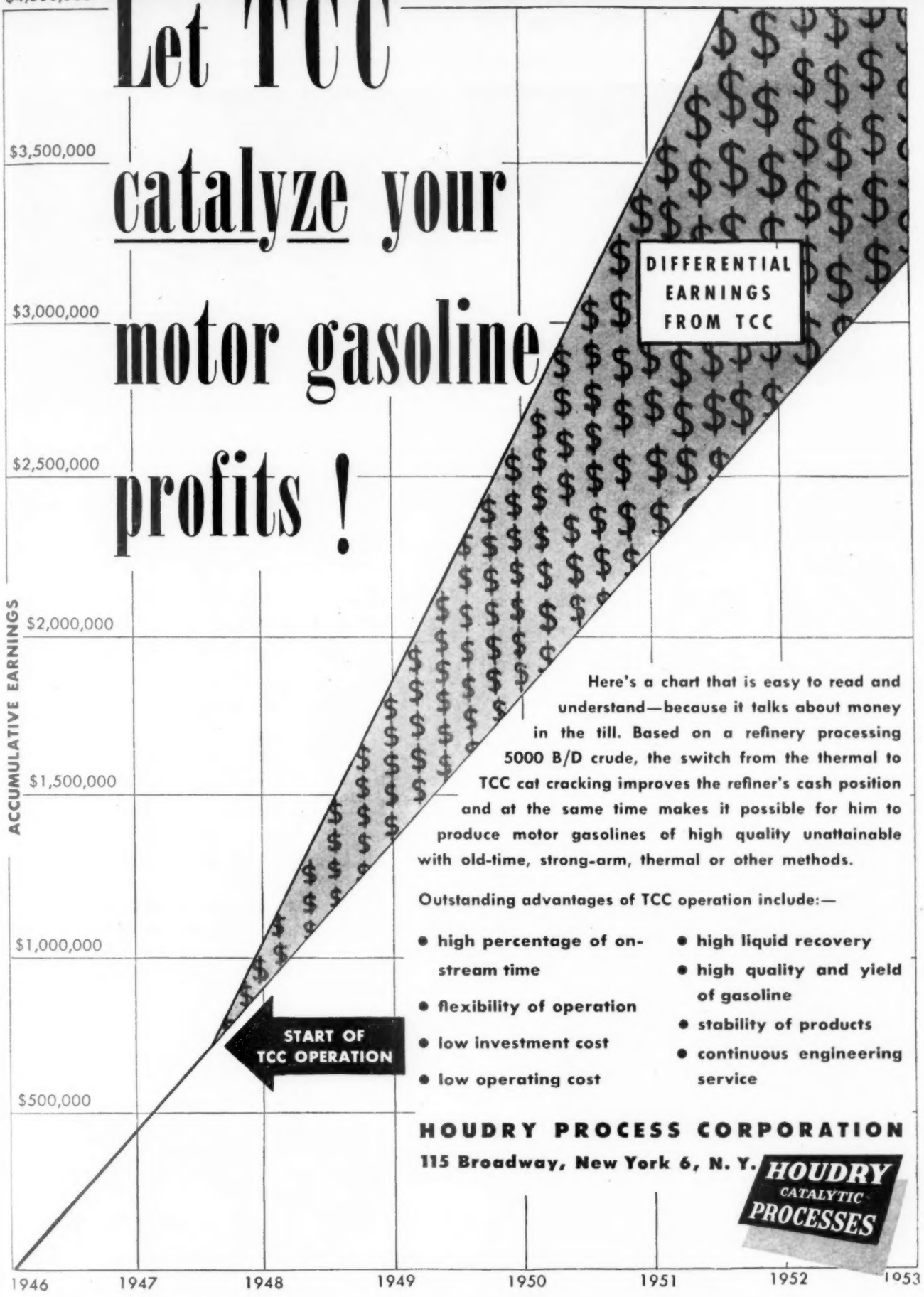

Here's a chart that is easy to read and understand—because it talks about money in the till. Based on a refinery processing 5000 B/D crude, the switch from the thermal to TCC cat cracking improves the refiner's cash position and at the same time makes it possible for him to produce motor gasolines of high quality unattainable with old-time, strong-arm, thermal or other methods.

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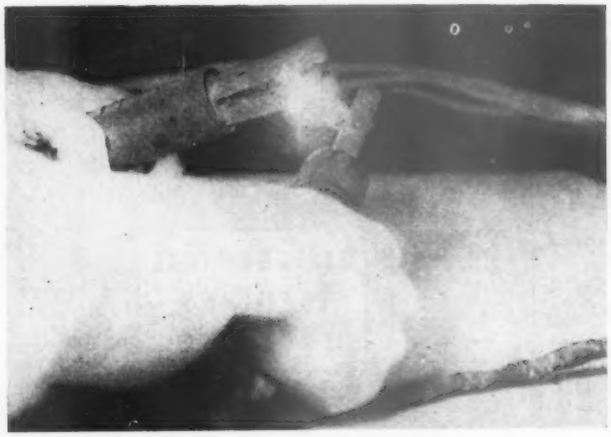


Photo 1—Preparing electrodes by resistance heating

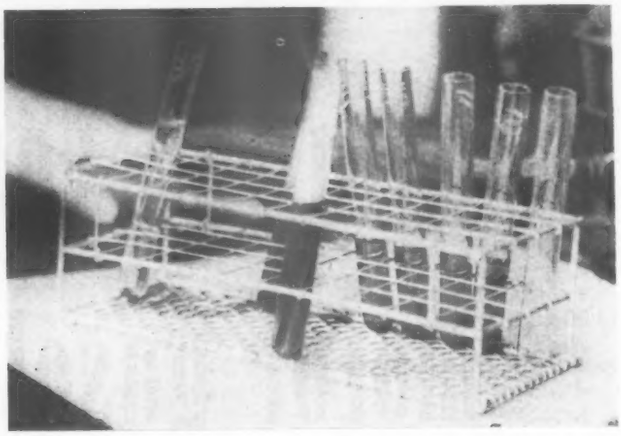


Photo 2—Electrodes soaking in oil sample

internal standard. In general that element in an alloy which is the major constituent of the alloy is used as an internal standard, providing it represents a large enough percentage of the alloy so that the spectral line density due to this main element will be relatively independent of concentration. In some nonferrous alloys spectrographers use as an internal standard an element whose concentration is as low as 80%. In the case of stainless steels, in which the percentage of chromium and nickel is relatively high, and the percentage of iron is relatively low, the intensity of the iron line will be found dependent on the iron concentration of the sample. Therefore the internal standard method must be greatly modified for the analysis of stainless steels.

In the analysis of various biological materials, such as urine and blood, there is no single element present in a sufficiently high percentage to be used as an internal standard. In such cases good results have been obtained by adding to the sample some element which will provide the proper spectrographic lines, and which can be added so as to represent approximately 95-98% of the sample.

Two things were immediately apparent when we attempted to analyze oils for phosphorus, barium, etc. First, there was no element present in the oil that could be used as a satisfactory internal standard, and second we could find no suitable element or compound which might be added to the oil for use as an internal standard.

Sometime ago one of the authors was interested in what was termed the "Total Energy Method". Essentially this meant that if the same amount of sample was consumed by the analytical discharge for every spectrum, then the resulting spectrographic line densities would be a function of concentration only. In such cases the procedure was to weigh a definite amount of sample into the crater of a carbon electrode and arc it to completion. It occurred to us that it was not possible to follow this procedure exactly with oils, but that we still might be able to develop some technique which would insure that the analytical discharge would consume a reproducible amount of sample for each analysis. These considerations lead directly to the following method of preparing oil samples and standards for spectrographic analysis.

TABLE 2—Standard Solutions and Their Additive Compositions

Standard Solution No.	Oil SUS @ 100° F.	Additive No.	Additive % by Wt.	Ca % Wt.	Ba % Wt.	Zn % Wt.	P % Wt.	Pb % Wt.	T.E.L. ml. gal.
1	200	1	8.0	.070	....	.085	.076	....	....
2	200	1	6.4	.056	....	.068	.061	....	....
3	200	1	4.8	.042	....	.051	.046	....	....
4	200	1	3.2	.028	....	.034	.030	....	....
5	200	1	1.6	.014	....	.017	.015	....	....
6	200	3	8.0	....	.284	....	.136	....	....
7	200	3	6.4	....	.225	....	.109	....	....
8	200	3	4.8	....	.171	....	.081	....	....
9	200	3	3.2	....	.114	....	.054	....	....
10	200	3	1.6	....	.057	....	.027	....	....
11	200	6	0.1	....	....	....	.005	....	....
12	200	6	0.5	....	....	....	.025	....	....
13	200	6	1.0	....	....	....	.050	....	....
14	200	6	1.5	....	....	....	.075	....	....
15	419.2	1	6.854	.060	....	.073	.065	....	....
16	89	1	6.991	.062	....	.074	.066	....	....
17	419.2	2	4.402	.024	.236	....	.025	....	....
18	89	2	4.366	.024	.234	....	.025	....	....
19	419.2	3	3.016	....	.108	....	.050	....	....
20	89	3	3.003	....	.108	....	.050	....	....
21	419.2	4	2.006	....	.072	....	.058	....	....
22	89	4	2.001	....	.071	....	.058	....	....
23	419.2	5	2.010	.01	....	.038	.034	....	....
24	89	5	2.010	.01	....	.038	.034	....	....
25	200	7	0.30	....	....	....	....	.092	....
26	200	7	0.24	....	....	....	....	.073	....
27	200	7	0.18	....	....	....	....	.055	....
28	200	7	0.12	....	....	....	....	.037	....
29	200	7	0.06	....	....	....	....	.018	....
30	3000	7	0.30	....	....	....	....	.092	....
31	3000	7	0.24	....	....	....	....	.073	....
32	3000	7	0.18	....	....	....	....	.055	....
33	3000	7	0.12	....	....	....	....	.037	....
34	3000	7	0.06	....	....	....	....	.018	....
35	....	8	....	....	....	....	....	....	.25
36	....	8	....	....	....	....	....	....	.50
37	....	8	....	....	....	....	....	....	.72
38	....	8	....	....	....	....	....	....	.94
39	....	8	....	....	....	....	....	....	1.46
40	....	8	....	....	....	....	....	....	1.97
41	....	8	....	....	....	....	....	....	2.49
42	....	8	....	....	....	....	....	....	3.00

Preparation of Samples

The oil samples are absorbed directly in special high purity ¼-in. graphite rods. These are then used to form the electrodes at the analytical gap of the spectrograph. The rods are cut approximately 2 ins. long and a 45° cone cut on one end of each of a pair to form the electrodes.

To make the graphite electrodes absorb the oil sample, it was found necessary to heat them in order to drive all gases from the electrode. The graphite electrodes then act like a wick which can be made to absorb the oil sample and feed it continuously to the analytical discharge. The first attempts were made by heating with a gas burner. This was

found impractical and so the following technique was adopted.

Each of the two graphite electrodes is held in a separate welding rod holder as shown in Photo 1. The holders are the terminal ends of a soldering transformer running off a 110-volt AC line and with an output of 40 volts. By shorting the two graphite electrodes as shown, they are heated rapidly and the temperatures to which they are heated can be controlled satisfactorily by noting color changes. Our procedure is to maintain contact of the electrodes at a distance ¼-in. from the cone shaped tip, until the electrodes are white hot from the point of contact to the tip. Each of the two hot electrodes is then dropped immediately into a 6-in. test tube containing 2 to 3 ins. of the oil sample. Photo 2.

The advantages of dropping the electrodes into the oil while still incandescant appear to be that all the gases have been driven from the graphite electrodes, and the heat reduces the viscosity of the oil. When the electrodes are dropped immediately into the oil they are quenched and the oil is absorbed into the spaces formerly occupied by the gases.

It is very important at this point to note that any dirt on the welding rod holders will contaminate the flat ends of the graphite electrodes and these, when dropped in the oil, may very well ruin a sample. It was therefore found advisable to clean the holders frequently with dilute hydrochloric acid.

The electrodes are allowed to soak in the oil sample for 5 minutes. Experiments showed the time interval is not critical after 5 minutes of soaking. After the soaking period, the electrodes are removed from the test tube, and excess oil removed on paper towels. The electrodes are then ready for the sparking cycle. It is of interest to note that for one test a single graphite electrode was cut 5 ins. long, heated at the conical tip and then dropped into the tube which was filled to a depth of only ½ in. At the end of 5 minutes soaking, it was found that the end which had not been in the oil was completely saturated with the oil.

The spectrograph shown in Photo 3 is a grating spectrograph with a dispersion in the first order of 7.0 angstroms per mm. and a dispersion in the second order of 3.5 angstroms per mm. The dispersion in the first order was found adequate for oil analysis, providing there was no iron in the oil as, for example, oil drained from a crankcase. In such cases it was found necessary to use the second order with its greater dispersion so as to separate the phosphorus lines from the iron lines.

The densitometer used for measuring spectral line density consists essentially of a constant light source which projects a beam of light through the spectral line to be measured on to a slit, behind which is mounted a photoelectric cell. The signal from the photoelectric cell is fed to a galvanometer and the deflection of the galvanometer read on a lamp and scale system. This is shown in Photo 4.

Our densitometer may be of sufficient interest to warrant some further description. When the spectrographic laboratory was first set up, a densitometer was used which employed electronic amplification. A great deal of difficulty was encountered with this system, because the spectrographic laboratory was situated within 15 ft. of automobile drive away lines and, regardless of the shielding installed on all leads and around the densitometer itself, radiation from the ignition systems of the motors made the densitometer unusable.

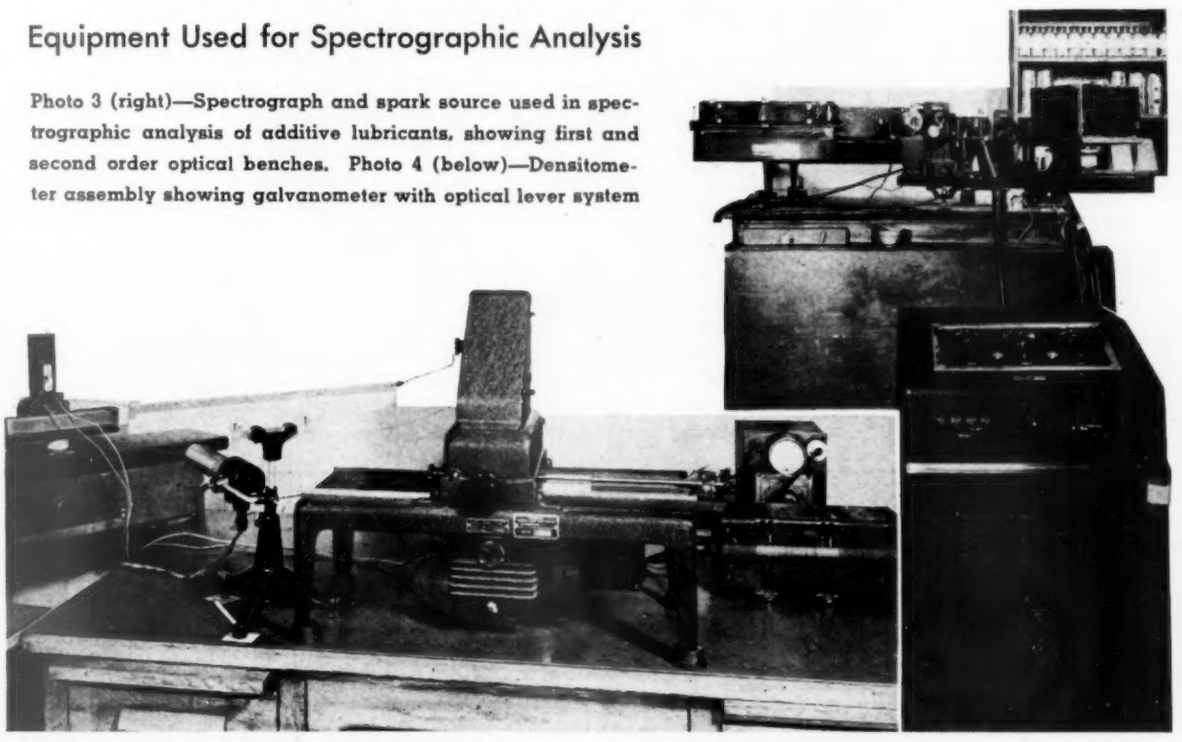
To overcome this difficulty we practically built our own densitometer. The projection system remained essentially as it had been in the old densitometer, but rather than a slit assembly coming down on the film, the image of the film was projected on a stationary slit. This accomplished several purposes, one of which was to make it unnecessary to have a uniform intensity of the projected light beam. The electronic amplifying system was replaced with a mirror galvanometer and optical lever system. The galvanometer has a sensitivity of .003 microampere per mm. at a scale distance of one meter, and a period of approximately three seconds.

Optical and Electrical Conditions

The spark source consists of four condensers of .007 microfarads capacity with a peak breakdown voltage of 20,000 volts each. These condensers are arranged in series—parallel so that the capacity of the group is .007 microfarads and the peak breakdown voltage is 40,000 volts. This group of condensers is paralleled across the output of the transformer, which is approximately 30,000 volts. One side of the condenser group feeds to a

Equipment Used for Spectrographic Analysis

Photo 3 (right)—Spectrograph and spark source used in spectrographic analysis of additive lubricants, showing first and second order optical benches. Photo 4 (below)—Densitometer assembly showing galvanometer with optical lever system



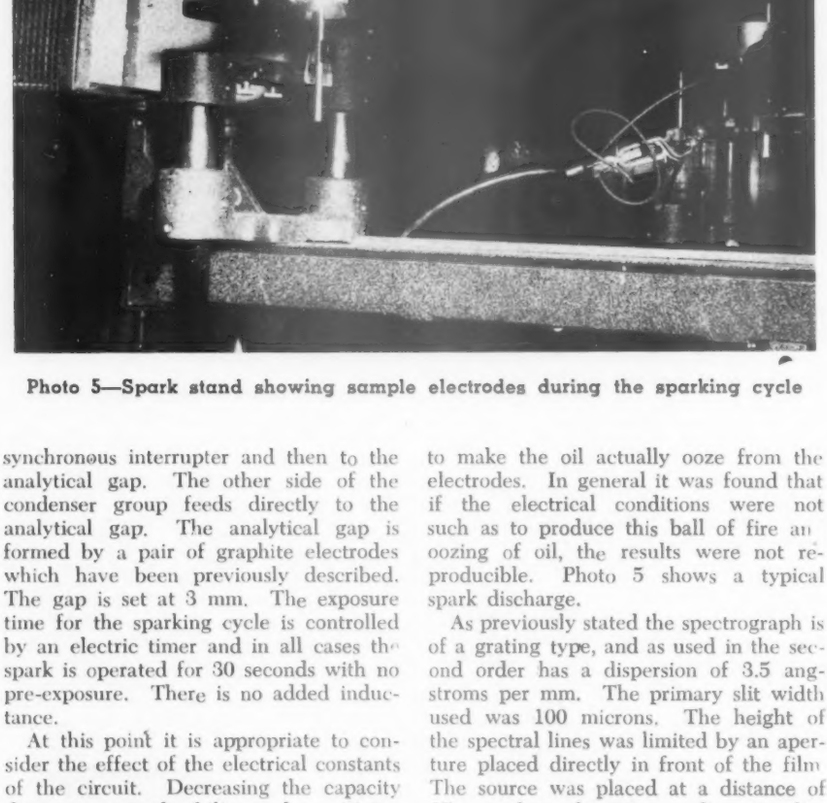


Photo 5—Spark stand showing sample electrodes during the sparking cycle

synchronous interrupter and then to the analytical gap. The other side of the condenser group feeds directly to the analytical gap. The analytical gap is formed by a pair of graphite electrodes which have been previously described. The gap is set at 3 mm. The exposure time for the sparking cycle is controlled by an electric timer and in all cases the spark is operated for 30 seconds with no pre-exposure. There is no added inductance.

At this point it is appropriate to consider the effect of the electrical constants of the circuit. Decreasing the capacity decreases reproducibility and sensitivity, especially for phosphorus. Increasing the time of exposure increases the ratio of background relative to phosphorus line intensity. Using electrodes with a sharper point than 45° decreased the relative intensity of the phosphorus line over background, to a point where the line is almost unobservable. Changes in the gap width have a very slight effect on relative line intensities.

The electrical conditions described above resulted in a spark discharge which can be very accurately described as a ball of fire, which produces enough heat to make the oil actually ooze from the electrodes. In general it was found that if the electrical conditions were not such as to produce this ball of fire an oozing of oil, the results were not reproducible. Photo 5 shows a typical spark discharge.

As previously stated the spectrograph is of a grating type, and as used in the second order has a dispersion of 3.5 angstroms per mm. The primary slit width used was 100 microns. The height of the spectral lines was limited by an aperture placed directly in front of the film. The source was placed at a distance of 35 cms. from the primary slit. A cylindrical lens of 5-in. focal length placed 12.5 cms. from the analytical gap was used to focus the analytical discharge vertically on the grating.

Background Used as Internal Standard

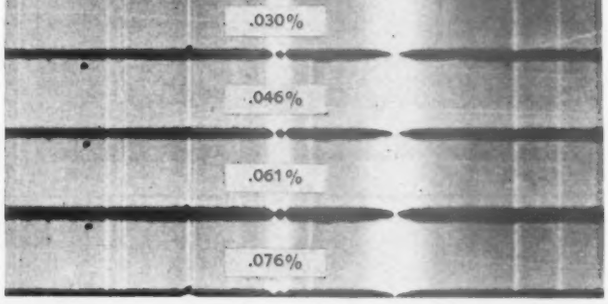
In the case of oil, it was pointed out that there was no element present that would meet the requirements of an internal standard. Yet it was required to have some measure which would indicate fluctuations in the light source for every oil spectrum. In a grating spectrograph, background is largely dependent on the ungrooved area of the grating, acting to reflect light of zero wave length to the film. The intensity of this light varies with source conditions. Therefore the intensity of this light integrated over the 30-sec. exposure time may well be expected to be a measure of the electrical conditions for a particular sparking cycle and the density produced as background may be used as an internal standard. In reading background the spectrum must be scanned at a point where there are no element lines even of very low density. It was found that background could be read with the highest degree of reproducibility at approximately 2540 angstroms, which is slightly above the analytical line for phosphorus. See Photo 6.

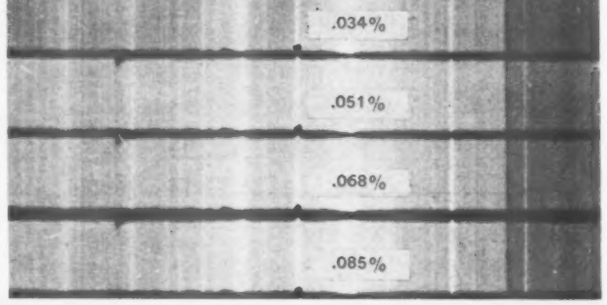
While running the standards and samples, it was noted that the density of the background was very nearly constant and that any large differences from this value indicated that the analytical results would not be acceptable. All such variations were traced to improper preparation of the sample and it was found possible toward the end of the work to almost entirely eliminate them. Small differences in the density of the background normally occurred and in these cases the background was found to act as a satisfactory internal standard.

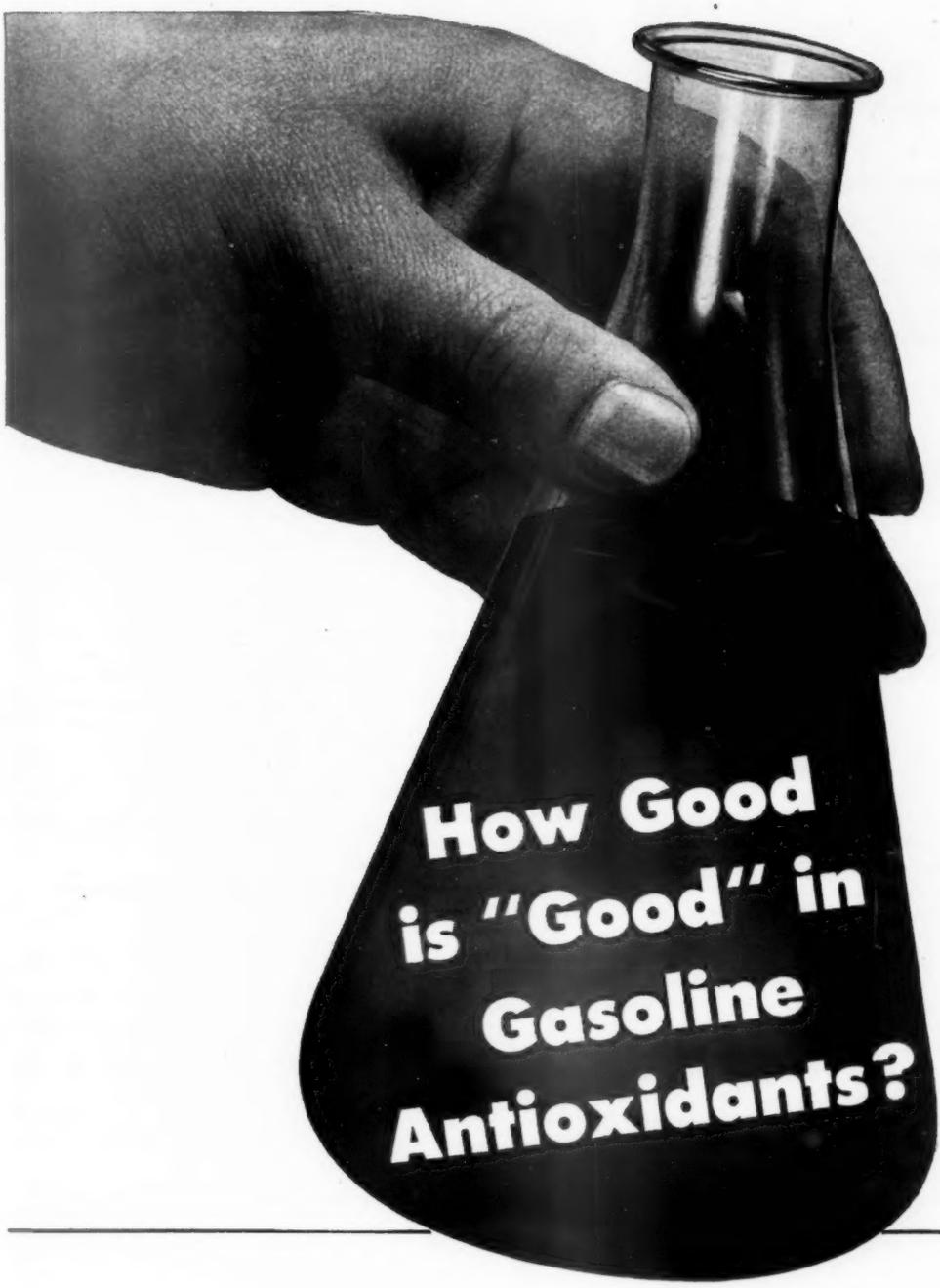
Phosphorus—There are four lines available for phosphorus. Of these, the one at 2535.62 angstroms (see Photo 6) is the most intense phosphorus line available on our spectrograph. It is to be noted that there are two other phosphorus lines of still greater intensity at 2136.79 and 2149.81 angstroms. These have not been found usable without specially sensitized photographic plates.

Zinc—For zinc there are three lines, any one of which may be used depending upon the concentration of zinc in the sample under investigation. For all of our work the zinc line at 3345 was

Photos 6 (left) and 7 (right)—Photo 6 is spectra showing phosphorus lines and point at which background is read. Note increasing intensity of phosphorus line with increase in concentration. Phosphorus—2535.62. Photo 7 is spectra showing zinc line. Zinc—3345.0







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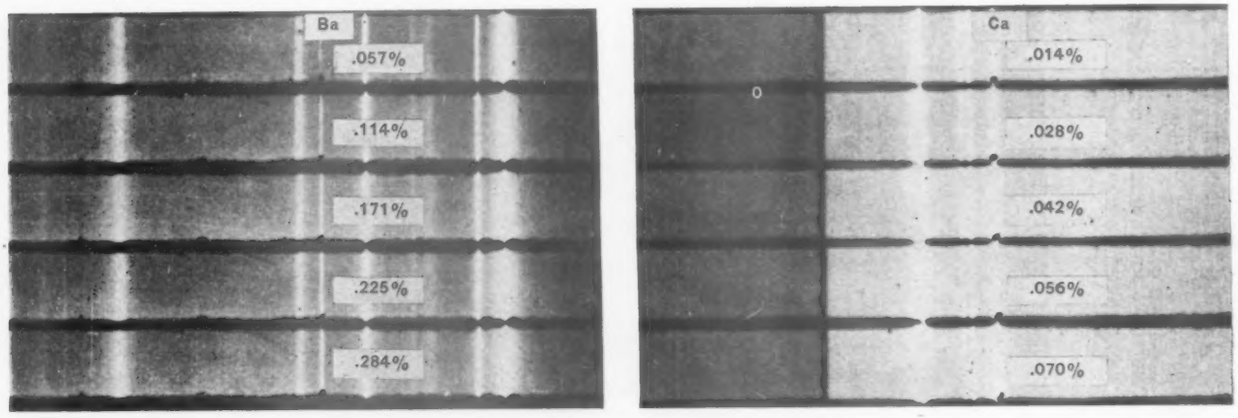


Photos 8 (left) and 9 (right)—Photo 8 is spectra showing barium line. Barium—2304.22. Photo 9 is spectra showing calcium line. Calcium—3179.34

found most satisfactory. See Photo 7.

Barium—The number of barium lines (Photo 8) available for use with our spectrograph is small, but the one at 2304.22 angstroms was found to give satisfactory results where the concentration range was .01% to .07%.

Calcium—For calcium there are several lines that may be used depending on the calcium concentration in the oil. For very small amounts the 3963 calcium line is satisfactory. For higher concentrations, the calcium line at 3179.34 is better. See Photo 9.

Lead—There are two lead lines, which we have found workable for oil analysis, one at 3633 and one at 2833.

Analytical Curves

The analytical curves were prepared by plotting log intensity ratios of the background versus the element line against the log of the percentage composition. All working curves were based on at least five standards.

Phosphorus—For this curve Standard Solutions No. 1 through 5 were used. The analytical curve for phosphorus, Fig. 1, shows a slight concavity downward, due to the fact that the density of the phosphorus line for low phosphorus concentrations approaches the density of the background. Over a period of many weeks the phosphorus curve showed only slight lateral shift and the slope did not change. See Fig. 4. It is interesting to note that extreme changes in the electrical conditions affected the ratio of the background to phosphorus line by only a very small extent. For example, it was possible to run a single sample for phosphorus without the synchronous interrupter in operation and find a background to phosphorus ratio of 1.07 and then use the interrupter and observe a ratio of 1.09, although the affect on the absolute densities of phosphorus and background were very great.

Calcium—For the calcium curve Standard Solutions No. 1 through 5 were used. The calcium curve has no feature of particular interest other than the fact that it may shift along the abscissa and should be checked regularly. See Figs. 2 and 5.

Zinc — Standard Solutions No. 1 through 5 were used to determine this curve. The zinc curve, Fig. 3, shows a concavity upward. In these working curves, the background is plotted against the zinc line at 3345 angstroms. In the case of zinc there was a definite tendency for the curve to shift from day to day. This simply means that the point at which the zinc 3345 line to background intensity ratio was unity, was displaced along the abscissa, but that the curves remained parallel.

It is important to point out here that spectrographers frequently find it necessary to make a regular check for the drift of analytical curves by following a rigid system of running standard samples. In the case of high percentage constituents of an alloy, they may require this check on the analytical curve as often as every two hours. It was found that by using a zinc standard oil sample once a day, the working curve could be located with all the accuracy required.

Barium—For this curve, Standard Solutions No. 6 through 10 were used. It was found that barium was essentially linear over the range studied. See Fig. 6.

Lead—For the lead curve Standard Solutions No. 25 through 34 were used. The working curve for lead is concave and does not show any tendency to drift from day to day. See Fig. 7.

One important problem in setting up working curves for the analysis of any

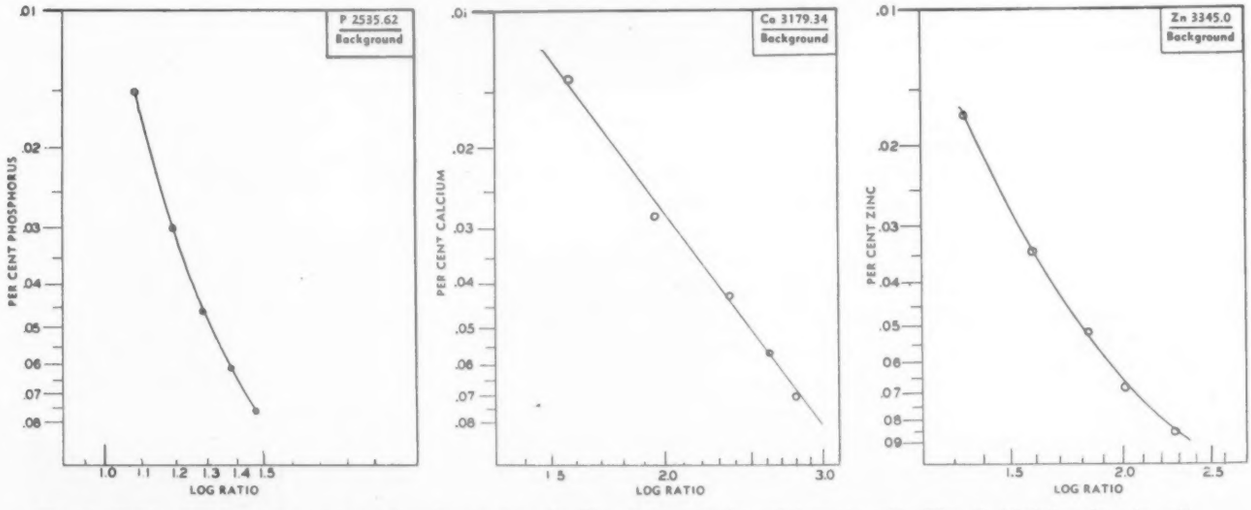


Fig. 1 (left)—Analytical curves, phosphorus in oil; Fig. 2 (center)—calcium in oil; Fig. 3 (right)—zinc in oil

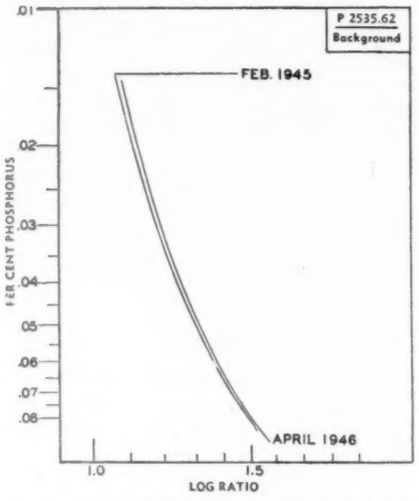


Fig. 4—Shift of analytical curve, phosphorus in oil

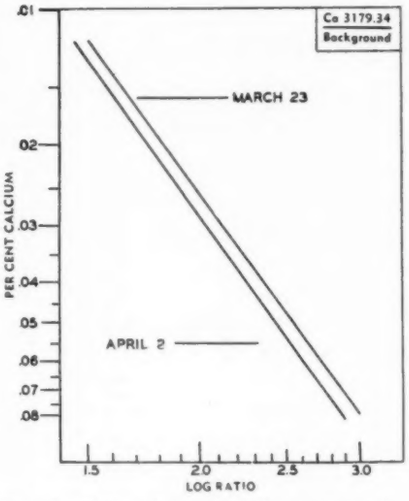


Fig. 5—Shift of analytical curve, calcium in oil

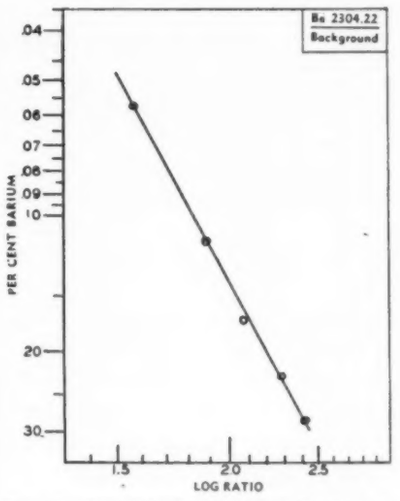


Fig. 6—Analytical curve for barium in oil

kind of sample is to determine the effect of any one element on the analysis of another. For example, in steel the presence of very small amounts of aluminum profoundly effects the analysis of silicon. No such relations were noted in the spectrographic analysis of oils. That is to say, a working curve drawn for the analysis of phosphorus in an oil containing only phosphorus would work just as well for an oil containing phosphorus along with some barium and zinc or calcium, over the ranges we have studied.

Effect of Viscosity of Oil

All the standards for the working curves were made with oil of 200 S.U.S. viscosity @ 100° F., and as shown on the previous curves excellent plots were obtained.

It now became of interest to determine what would result in the analysis of oils of greater or less viscosity. A series of standards were made up which consisted of oils of two different viscosities, Standard Solutions No. 15-24. These were run and determined on the regular curves for 200-second oil. Within the viscosity limits of 89 S.U.S. to 419 S.U.S. @100° F. no difference was to be found in the spectrographic results for any of the elements determined.

However, toward the end of this project our interest was again focused on the effect of viscosity, and regular curves were constructed for a series of Standards in 200 S.U.S. @ 100° F. oil and another in 3000 S.U.S. @ 100° F. using lead naphthenate. In this extreme case of the high viscosity oil there was a definite shift in the lead analytical curve. See Fig. 7. It is believed that in routine control of oil additives it will be necessary to have working curves to cover several different viscosity ranges.

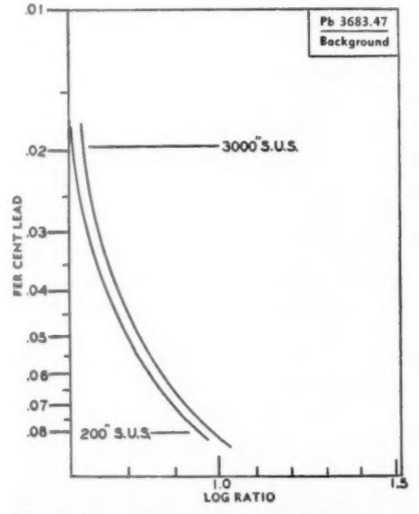


Fig. 7—Analytical curves for lead in oil, showing the effect of large differences in viscosity

Analysis of T.E.L. in Gasoline

It was found desirable to be able to determine the percentage of lead in gasoline spectrographically. The same technique was applied to the analysis of gasoline as was used for oils. Hot graphite electrodes with 45° cones were heated and then dropped in 1-in. dia. test tubes containing approximately 3 ins. of gasoline. By allowing the electrodes to cool from white heat to black before dropping into the gasoline it was found there was no danger of fire as long as there was sufficient gasoline to cover the electrodes. It was found advisable to immerse the test tube of gasoline in a beaker of cold water. This effectively prevented the gasoline from boiling out of the tube.

Using this method for preparing samples, a run was made of various gasolines (Standards No. 35 to 42). A plot of these standards showed irregularities due largely to the burning of the gasoline during the sparking cycle. There is also evidence of its being related to the differential absorption of the tetraethyl lead. Further experiments were conducted by adding a drop of concentrated hydrochloric acid to the gasoline immediately before dipping the electrodes. This resulted in a colloidal suspension of lead chloride. Using standards prepared in this way, the lead curve shown in Fig. 8 was obtained. Re-runs on the same samples were found to give the same ratios within very close limits. This indicates the practicability of determining lead in gasoline with the spectrograph. We feel that because of the speed and ease with which these analyses may be carried out that further

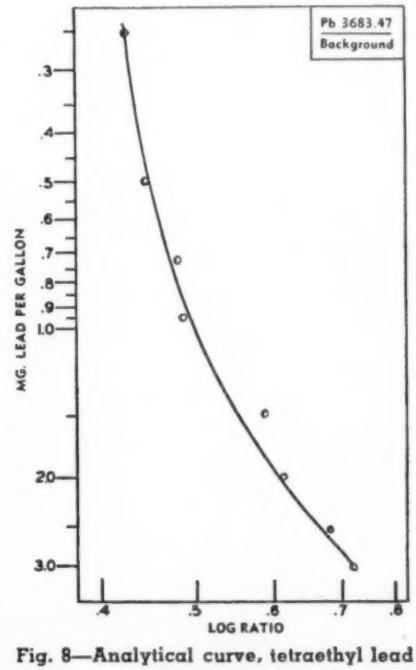


Fig. 8—Analytical curve, tetraethyl lead in gasoline

TABLE 3 Results of Routine Spectrographic Analyses

Standard Solution No.	Ca % Known	Ca % Found	Ba % Known	Ba % Found	Zn % Known	Zn % Found	P % Known	P % Found
1	.070	.070	....	....	.085	.085	.076	.076
2	.056	.058	....	....	.068	.070	.061	.061
3	.042	.045	....	....	.051	.052	.046	.046
4	.028	.028	....	....	.034	.034	.030	.035
5	.014	.015	....	....	.017	.018	.015	.015
6	....	....	.284	.280	....	....	.136	.136
7	....	....	.225	.240	....	....	.109	110
8	....	....	.171	.180	....	....	.081	.081
9	....	....	.114	.110	....	....	.054	.054
10	....	....	.057	.060	....	....	.027	.028
15	.060	.065	....	....	.073	.080	.065	.067
16	.062	.067	....	....	.074	.075	.066	.067
17	.024	.025	.236	.230	....	....	.025	.025
18	.024	.025	.234	.240	....	....	.025	.024
19	....	....	.108	.110	....	....	.050	.050
20	....	....	.108	.108	....	....	.050	.050
21	....	....	.072	.070	....	....	.058	.055
22	....	....	.071	.070	....	....	.058	.055
23	.010	.010	....	....	.038	.040	.034	.035
24	.010	.010	....	....	.038	.040	.034	.035

Standard Solution No.	Pb % Known	Pb % Found	T.E.L. ml./gal. Known	T.E.L. ml./gal. Found
25	.092	.092	....	....
26	.073	.075	....	....
27	.055	.060	....	....
28	.037	.038	....	....
29	.018	.018	....	....
30	.092	.092	....	....
31	.073	.071	....	....
32	.055	.055	....	....
33	.037	.037	....	....
34	.018	.017	....	....
35	....	....	.25	.25
36	....	....	.50	.48
37	....	....	.72	.69
38	....	....	.94	.90
39	....	....	1.46	1.50
40	....	....	1.97	1.88
41	....	....	2.49	2.40
42	....	....	3.00	3.00

work is justified and will make this method feasible for analytical control.

Time Required for Analysis

The operation of pouring the samples into test tubes requires about 1 minute for 10 samples. Heating the electrodes takes about 15 seconds a pair, so that 10 pairs will require roughly 3 minutes. All electrodes are required to soak 5 minutes. Drying 10 pairs of electrodes on paper thoroughly to remove excess surface oil requires about 2 minutes. The actual sparking cycle for 10 pairs of electrodes may require 10 minutes. Developing the film requires approximately 6 minutes. Reading the film and converting the densitometer reading to percentage composition on 10 exposures requires 10 minutes if all operations are done simultaneously.

It can therefore be expected that a complete analysis for phosphorus, barium, calcium and zinc, on 10 oil samples will require approximately 40 minutes. Since two men are employed for this work, 1.33 man-hours are required to make 10 oil analyses involving 40 separate determinations. The same 10 oil samples analyzed by experienced chemists, using the chemical procedures outlined in this paper will require a minimum of 40 man-hours.

By properly arranging the spectrographic equipment, and employing another less skilled worker to prepare samples and develop film, the time required per analysis can be reduced by about 50%.

Results

The standard solutions were given to the chemists operating the spectrograph at various times for routine work. The identity of the standard was changed so that it was unknown to the chemists. Only one sample was run of each standard so that there were no re-checks. This procedure indicated the results which could be expected on routine work. Table 3 gives the results compared with the known content of the standard solutions.

Note that the greatest error in the additive oil analyses was .015% in the analysis of barium in Standard Solution No. 7. Only four other analyses showed errors over .005% and they were less than .010%. The average error for additive oils was 0.002%. In the tetraethyl lead analysis the greatest error was 0.09 ml/gal. The average error for the gasoline analyses was 0.033 ml/gl.

Two test cars using the same brand of motor oil were drained at 5000 miles. Table 4 shows the chemical and spectographic analyses for calcium, zinc, and phosphorus of these oils. The oils were centrifuged free of sludge before making the analyses.

Conclusions

1. We have presented a method of chemical analysis which is faster and as accurate as A.S.T.M. Methods D-811-44T and D-809-44T for the analysis of metals and phosphorus in lubricating oils.

2. We have shown that quantitative analyses of phosphorus, calcium, barium, zinc and lead in lubricating oils or lubricating oil additives can be made in a few minutes by the spectographic technique presented. We believe that other metallic elements can also be analyzed by this method.

3. This spectrographic technique may be applied to materials other than oils and thus increases the scope and efficiency of the control chemist.

4. The saving in man-hours per analysis is so great that the costly equipment involved soon pays for itself.

5. Although the results for the analysis of tetraethyl lead in gasoline are not as consistent as the results for lead in oil, the authors are convinced that the difficulties may be overcome. Therefore a little more experimenting should bring the accuracy of these analyses in line with that of lubricating oils.

Acknowledgment

The authors wish to express their appreciation to Mr. D. G. Roos, Vice President in Charge of Engineering, for his interest in and sponsorship of this work, and to the chemists of the Chemical Laboratory at Willys-Overland Motors, Inc., who have contributed their knowledge and skill. Without their wholehearted co-operation and many helpful suggestions, this work could not have been accomplished.

The following companies furnished the additives and oils used in this work: Ethyl Corp., Fiske Brothers Refining Co., Kendall Refining Co., Lubri-Zol Sales Co., Monsanto Chemical Co.

TABLE 4—Chemical and Spectrographic Analyses of Used Motor Oils from Test Cars

Test Car	Ca % Chem.	Ca % Spec.	Zn % Chem.	Zn % Spec.	P % Chem.	P % Spec.
5	....	.017	....	.023	....	.033
	.018	.020	.023	.023	.032	.032
	....	.018	....	.025	....	.032
6	....	.015	....	.019	....	.030
	.015	.016	.018	.018	.030	.031
	....	.016	....	.020	....	.032

CHEMICALS from PROPANE

By J. E. Bludworth
Celanese Corp. of America

An authority from the chemical field discusses the manufacture of chemicals from light petroleum fractions. He limits himself to one hydrocarbon, propane, and also to a few of the better known products which are oxygenated compounds derived from propane; thus emphasizing, stronger than by words, the wide possibilities as to number of petrochemicals.

However, economic factors must be considered in the successful marketing of a new chemical, which are often more important than the manufacture of the by-product itself. Among these are: distance to consumers, convincing manufacturers to change their methods and equipment to use a new chemical, impact on the price structure and market demand of new and perhaps low cost sources of supply. The successful marketing of new chemicals is based on the result of many years of promotion, advertising and sales effort, it is brought out by the author.

BECAUSE of technical advances in recent years, limitations of both space and time require that I confine the discussion of chemicals from lighter hydrocarbons to one hydrocarbon—propane. Numerous writers have already covered the field. Many of the by-products mentioned by these authors originated in the notes of technical individuals and have not been further explored. However, there have been outstanding examples of important products being recovered from propane, and almost each day research discovers additional outlets for propane through new and more valuable products.

Rather than try to elaborate on all the possible by-products that might be recovered, such as through chlorination of propane or hydration of propylene or through nitration of the same hydrocarbon, this discussion will be limited to a simple diagram illustrating the better-known products that might be obtained from propane. Also, we'll include the various products that might be obtained from acetaldehyde, acetone, propionic aldehyde and formaldehyde, which are oxygenated derivatives of propane.

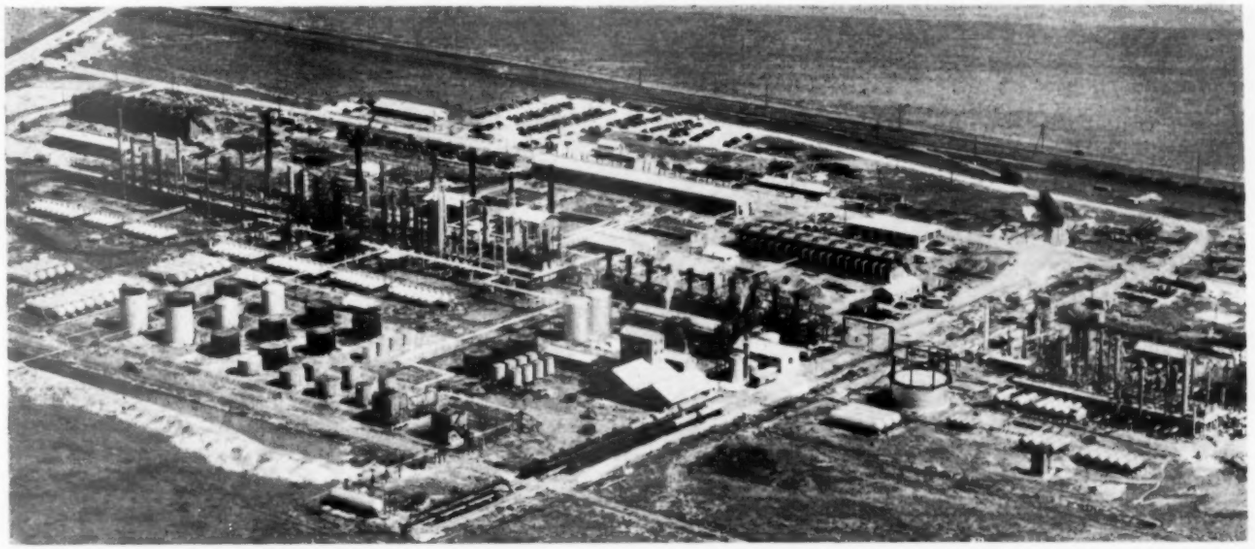
The above article is the principal portion of a paper presented before the Natural Gasoline Association of America, Dallas, April 18, under the title, "Chemicals from Light Hydrocarbons".

Acetaldehyde, one of the most versatile of chemicals, is being used at the present time for the production of probably more secondary products than any other chemical compound. Acetaldehyde can be converted by hydrogenation to ethyl alcohol or by oxidation to acetic acid or acetic anhydride. In addition, acetic acid can be converted in almost theoretical yields to acetone as well as to other ketones.

Ethyl alcohol from acetaldehyde can be combined with acetic acid or acetic anhydride to form ethyl acetate; also, ethyl alcohol can be catalytically pyrolyzed for the production of butadiene. Substantial quantities of butadiene and synthetic rubber have been produced by this well-known chemical process.

A far less well-known method in the U. S. of producing butadiene from acetaldehyde is by the aldol method. This method was not used in the recent rubber program to any large degree, although it has been used for many years in Germany and was a standard method there for producing 1,3-butadiene for synthetic rubber manufacture. The aldol method, as developed in this country, produced almost theoretical yields of butadiene from the starting acetaldehyde.

The aldol method comprises three or possibly four steps. Acetaldehyde is con-



Airview of new chemical plant of Celanese Corp., near Bishop, Texas, which produces methanol, acetone, acetic acid, acetic anhydride, formaldehyde, acetaldehyde and other chemicals from butane and propane storage

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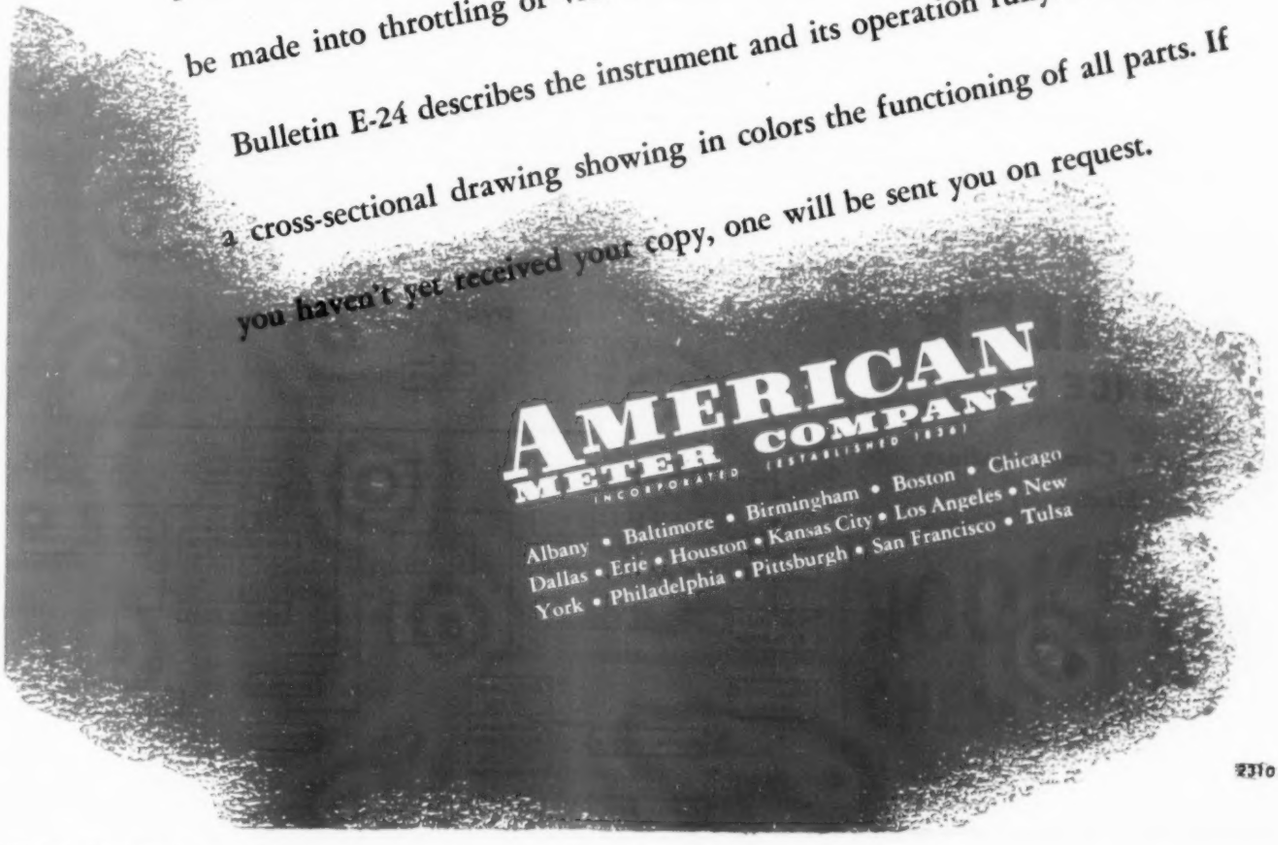

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densed with an alkaline catalyst to aldol, then hydrogenated in the liquid phase catalytically to 1,3-butylene glycol and then dehydrated to butadiene. If alcohol is the starting compound, a fourth step must necessarily be added. Butadiene so obtained requires no purifying extraction, since a simple rectification of the product produces a very pure butadiene.

In connection with the production of butadiene from acetaldehyde by way of the aldol method, it is interesting to note that by extensive aldoling it is possible to arrive at compounds totally dissimilar to the parent acetaldehyde and more nearly similar to propane itself. Aldol through simple dehydration will produce theoretical yields of crotonaldehyde, which on oxidation will give maleic anhydride. By combining maleic anhydride with butadiene there is formed tetrahydrophthalic anhydride, which compound is very similar to phthalic anhydride. Through decarboxylation and dehydrogenation, tetrahydrophthalic anhydride can be converted to benzene.

Crotonaldehyde, the dehydrated product of aldol, will produce alcohols on simple hydrogenation. If aldolization is carried on beyond the first simple condensation, the higher alcohols such as octyl- and lauryl can be made. These alcohols are extremely high boiling and a number of uses have been found for them.

Lactic acid, a product normally found in and produced from milk, is generally considered one of the by-products or derivatives of the dairy industry. Through a series of complicated steps which involve condensation and hydration it is possible to convert acetaldehyde to lactic acid. This operation has been carried out in the laboratory with indifferent success but with the proper stimulus could undoubtedly be made a very successful reaction.

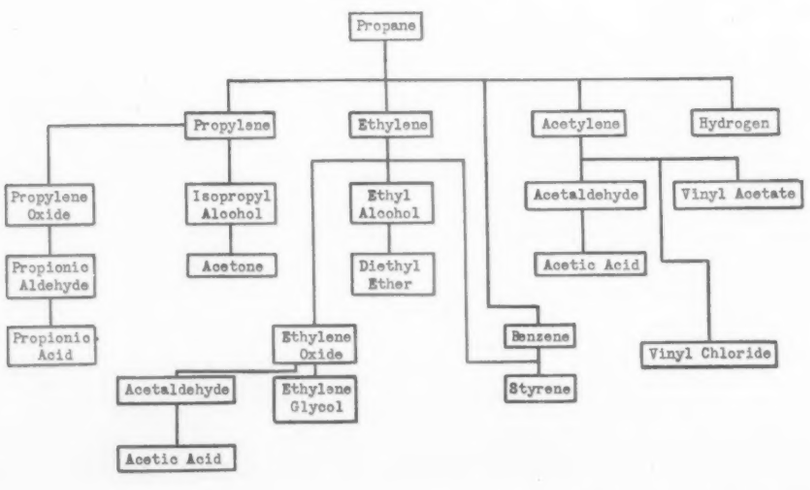
It is well known, also, that formaldehyde can be made from propane. Formaldehyde has long been known to investigators in the chemical field but it has been only in recent years that its value has become greatly enhanced by use in new synthetics as well as the older plastic products. Through formaldehyde condensation reactions and proper refining it is possible to obtain a syrupy compound having a sweet taste and the general appearance of the usual water-clear vegetable syrups. Hydrogenolysis of this material will yield glycols and glycerine.

In recent years, due to the technical advances resulting from the war effort as well as the increasing demand for various products they contain, the cost of certain chemicals derived from hydrocarbons is approaching the cost of the hydrocarbons themselves. As this point is reached it becomes increasingly interesting to consider the possibility that through unusual organic reactions it may be possible to produce hydrocarbons of extremely high octane value. As an example of this, acetone, which can be produced from acetaldehyde directly or by way of acetic acid, on dehydration will produce mesitylene, which has an octane value of 161.

While this discussion has been confined to the more common oxygenated compounds derived from propane, it might be mentioned that propane, as well as other hydrocarbons, can be pyrolyzed to acetylene and to aromatic hydrocarbons. Recent metallurgical advances have reopened the field with the possibility that this type of reaction will be employed more in the future than it has been to the present time.

Graphical diagrams have been prepared for review in conjunction with this article. However, a deeper and more thorough understanding of the economics of by-product manufacture from propane or any hydrocarbon should be presented in the true light of the massive problems that are always involved in placing on the market additional chemical materials. By this it is meant that the successful marketing of any new chemical or any chemical by any new process is usually very difficult.

PYROLYSIS



Primarily, the location of a large consumer of your product is a problem far more important than the actual output of the chemical by-product itself.

Too often we are influenced by the description of some new and spectacular chemical that is quite certain, if we can believe the words of the promoter, to revolutionize industry. While it is true that the chemical may have possibilities that make it extremely valuable and open the way for an interesting future, the impact on the price structure of any new, and up to this time relatively rare chemical, would be tremendous. Manufacturing industries that have been consuming other chemicals cannot be expected to alter their equipment overnight in order to utilize a new chemical.

The successful marketing of new chemicals is based on the result of many years of promotion and advertising and the convincing of hard-headed business men that the expense of manufacturing change-over is worth the advantages to be gained. This business procedure, which has nothing to do with the evolution of new chemicals and for which the chemists and chemical engineers are not accountable, has an extremely important bearing on the entire success of the endeavor.

Most companies now have sales research organizations that control the production of any chemical until markets can be promoted that will handle their output. The very fact, therefore, that a chemist does produce a new compound which can be made in large quantities from propane or any other hydrocarbon does not mean that this outlet has a real importance to the petroleum industry.

In 1944 there were produced in the U. S., under the impetus of the war program, approximately 800,000,000 pounds of acetic acid and acetic anhydride. Quoted as such, the figure is impressive. However, in the same year it is estimated that approximately 13,000,000,000 pounds of propane were available in U. S. and 2,000,000,000 pounds were sold. It is evident that there is very little opportunity for the consumption of a large portion of this propane supply for the manufacture of acetic acid.

The manufacture of cellulose acetate synthetic yarn probably represents one of the largest single outlets for acetic acid and acetic anhydride. However, it has taken 20 years or longer for cellulose acetate to reach its present peak of some 250,000,000 pounds per year.

In considering the problem of obtaining an outlet for your excess propane it might be better to consider its utilization into a well-known by-product, rather than contemplating the possibility of creating a relatively rare and unknown chemical that would absorb large quantities of the propane production. It is a common occurrence now to see on highways trucks transporting Liquefied Petroleum Gas for utilization in homes in outlying areas. Tremendous quantities of propane-butane

Five Processes that Profit by Hooker Anhydrous Aluminum Chloride

1. Alkylation or Condensation
2. Cracking
3. Refining
4. Polymerization
5. Isomerization

Here are five common applications of Hooker Aluminum Chloride as a catalyst in the petroleum field.

1. Alkylation or Condensation of paraffins with olefins to manufacture motor fuels; of aromatics with higher olefins or alkyl halides; to synthesize pour point depressants for lubricating oils.
2. Cracking of high-boiling hydrocarbons to manufacture gasoline.
3. Refining by decomposition of organic sulfur compounds by polymerization of gum forming constituents.
4. Polymerization of low-boiling hydrocarbons to manufacture motor fuels and lubricants.
5. Isomerization to manufacture branched paraffins of high anti-knock value, to effect ring closure of aliphatic hydrocarbons, to confer increased aromaticity.

If these processes are included in your operations or if you have any others where Aluminum Chloride is used as catalyst, it will pay you to use Hooker Anhydrous Aluminum Chloride. Uniform high purity of this Hooker Chemical accounts for its wide spread popularity in the petroleum field. For consistently dependable Anhydrous Aluminum Chloride, specify Hooker.

PHYSICAL PROPERTIES

Aluminum Chloride, Anhydrous—$AlCl_3$

Molecular Wt.	133.3
Solubility, gms/100 gms solvent	
Nitrobenzene	26.6 at 20°C
Orthonitrobenzene	22.6 at 20°C
Heat of Solution	550 small cal./gm. min.
Description	Gray, crystalline solid in three sizes
Analysis	
Aluminum Chloride	99% Min.
Iron	0.05% Max.

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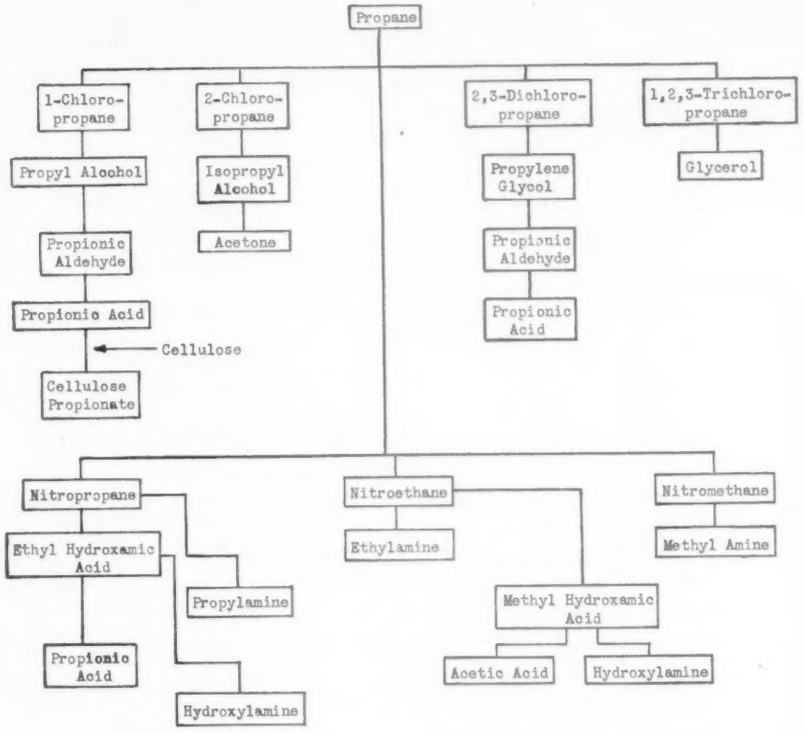


are used in this manner; yet the promotion, advertising and development of this outlet for propane-butane is the result of acquainting the public with the advantages to be gained and not the result of technical advances. The necessity for having a consumer for a product has been evident in every successful development associated with chemical by-product from petroleum.

Economic success attendant to the story of butyl alcohol and chlorinated hydrocarbons is associated with the successful utilization of these compounds in the quick-drying lacquers now being used in the automobile industry. There was a definite need for quick-drying lacquers. It is problematical whether both products would have been successfully marketed, as they now have, without the research which resulted in the utilization of chlorinated hydrocarbons and butyl alcohol.

With the consideration of mass production of common and well-known chemicals, it must be remembered that there will be an attendant reduction in sales price. However, with the reduction in sales price, the consumption will increase accordingly. In examining the possible outlets for chemical by-products from hydrocarbons and in studying the economic factors involved, the well-known and oft quoted sales price should not be considered as too reliable. The margin of profit will always be considerably less during the mass production of any chemical and the engineering economy in the chemical process should be carefully considered.

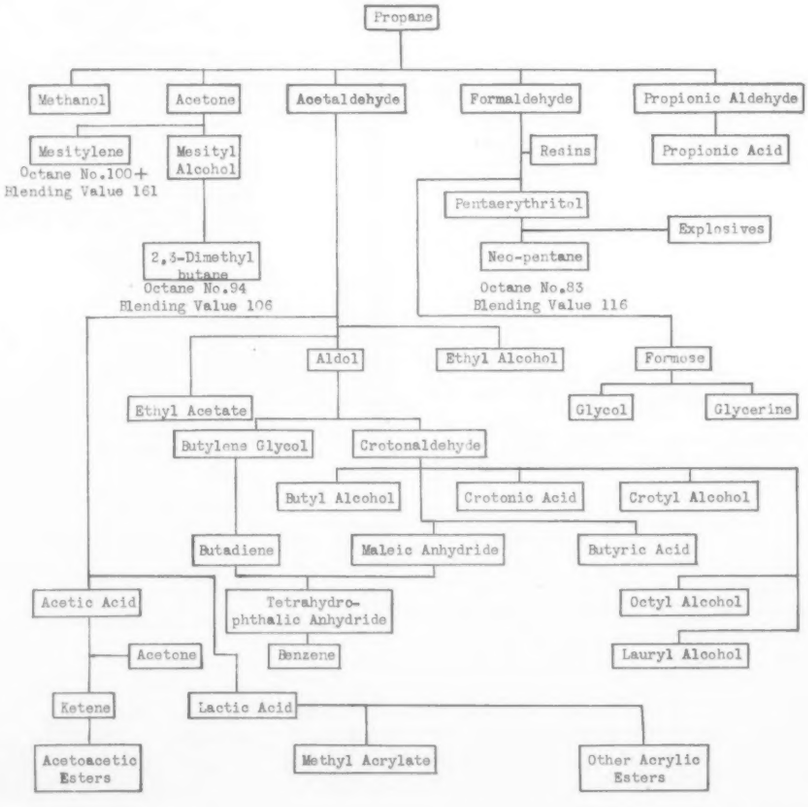
For example, acetic acid has been sold in recent years for as low as four cents per pound. In this same period the yearly production has been as high as 800,000,000 pounds. Also, in this same period with production lows far beneath the maximum level, the price reached was as high as 7.5 cents per pound.

A casual survey of the quoted prices on chemicals would indicate that, as an example, glyoxal can be purchased for $115 per pound. Glyoxal can be made from propane. However, since the yearly consumption of glyoxal represents only a few pounds, it is conceivable that if the manufacture of glyoxal from propane was carried out on a scale large enough to make the operation commercially feasible, the price structure, in all probability, would completely dissolve.

Mention of the above has been brought into this discussion primarily to point out the attendant difficulties associated with the launching of a new product on the market. It is hoped that the manufacturers of propane or LPG will both utilize and appreciate the rapid advances made in recent years in sales value and will take these factors into consideration before having too much faith in the prospects of moving large amounts of propane into by-product fields other than motor fuel manufacture.

No longer should the old and popular conception prevail of the wild-eyed, psuedo-scientist being the source of new products possessing possibilities of commercial success in the by-product field. The actual score shows that the greatest success has been achieved through making the public fully appreciative of the advantages in new chemicals and by using sound engineering principles.

OXIDATION



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Patent Trends in Petroleum Refining

By Peter J. Gaylor

Patent Attorney and Editor "The Technical Survey"

New developments disclosed in patents reviewed below include:

New method in acid treating lubricating oils to aid in the separation of sulfonate soaps.

Treatment for alkaline waters in cooling towers to retard the growth of algae.

Accelerating thermal cracking reactions by the addition of certain materials to the feed stock.

Acid Treating Lubricating Oils

In the manufacture of lubricating oils, it is common practice to contact the oils with sulfuric acid, of 66° Be up to and including fuming acid, usually at somewhat elevated temperatures, for a sufficient time to react the more reactive oil components, after which the sludge is removed and the oil neutralized with alkali. Continuous treating is employed with centrifugal separation of sludge, but neutralization is usually carried out in batch operation, mainly because of careful attention necessary to avoid emulsions.

The oil soluble sulfonate soaps resulting from the neutralization of the oil are now recovered and used in many commercial products. These soaps, however, are powerful emulsifiers and considerable difficulty is usually encountered in their efficient separation.

In Tidewater Associated Oil Co.'s patent 2,400,298, the more unstable oil soluble sulfonic acids are removed from the oil prior to neutralization, thus markedly improving the quality of the soap product and minimizing greatly the emulsion difficulties which appear to be due mainly to the unstable sulfonic compounds. The latter are also more corrosive in nature and thus tend to contaminate the soap with iron compounds.

The invention involves giving enough time, after centrifuging the sludge, for the unstable oil soluble sulfonic acids to polymerize and drop out, re-

TABLE 1—Comparison of Results by New Lubricating Oil Treating Method with Results by Conventional Technique

	Process according to invention	Conventional procedure
Lube distillate charged (bbl./day)	1,000	1,000
Acid treated oil from first centrifuges (bbl./day)	740	740
Acid treated oil from second centrifuges (bbl./day)	728	
Oil charged to agitator (bbl.)	728	740
4° Bé. caustic soda used (lbs. NaOH)	500	940
Theoretical caustic soda required (lbs.)	460	890
Neutral oil recovered (bbl.)	710	703
Crude sulphonic soaps (bbl.)	18	37
Oil in crude sulphonic soaps (%)	50	75
Fe_2O_3 in crude sulphonic soaps (%)	.002	.05
Time required for spent caustic to settle from neutralized oil (hr.)	6	18

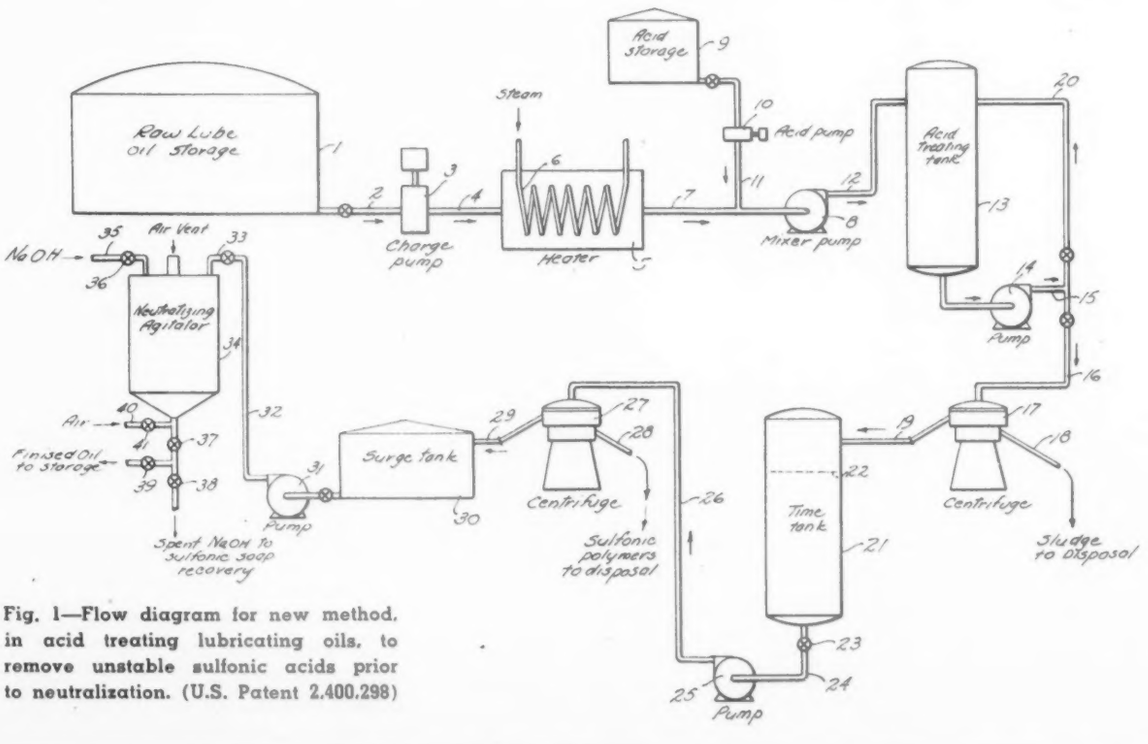

Fig. 1—Flow diagram for new method, in acid treating lubricating oils, to remove unstable sulfonic acids prior to neutralization. (U.S. Patent 2,400,298)

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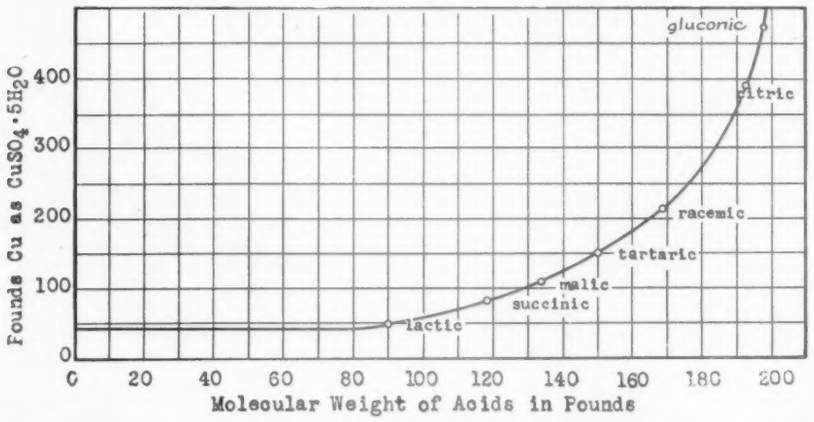

Fig. 2—Weights of water soluble-nonvolatile organic acids that will render Cu ions soluble in highly alkaline (pH 9-10.5) waters. (U.S. Patent 2,400,863)

moval being accomplished by recentrifuging. Best results are obtained when the standing time for polymerization is about 45 minutes (at 80-160° F.).

The equipment employed is shown in Fig. 1. Oil from tank 1 is pumped into heater 5, mixed with acid in mixer 8 and run into acid treating tank 13 provided with recycling pump 14. Upon centrifuging at 17, the sludge is removed and the oil is run into tank 21 to allow polymerization of unstable acids to take place. Thereafter, the oil is pumped into centrifuge 27 which removes separated polymers and is neutralized in agitator 34.

Data shows that the acidity of the oil leaving the first centrifuge drops on standing from 1.20 lbs. NaOH per bbl. to about 0.67 lb. after 45 minutes. Data given in Table 1 compare the results obtained by the new method with those obtained by the conventional technique. Although only half the yield of crude soaps is obtained, the soaps contain much less oil and iron, and the time required to settle the spent caustic is reduced to one-third.

Hydraulic Oils

The usual glycerol and castor oil-alcohol type hydraulic oils are claimed to have a number of practical disadvantages, such as wide changing of viscosity over narrow temperature ranges, corrosive and degrading effects on rubber and metal parts, vaporization or solidification, etc. Shell has proposed the use of a sulfolane or alpha sulfolene as one of the main ingredients in hydraulic oils in order to avoid such troubles (U. S. 2,394,251).

Some of the compositions proposed and their properties are given in Table 2.

TABLE 2—Composition and Properties of Hydraulic Oils Containing a Sulfolane
(From U. S. Patent 2,394,251)

Pts. by Vol.	Ingredient	Properties of Composition
25	2,4-Dimethylsulfolane	S.U. Vis./100° F., 130 Sec.
40	Castor Oil	Pour Point—55° F.
32.5	Diacetone Alcohol	
2.5	Inhibitor	
25	2, 4-Dimethylsulfolane	S.U. Vis./100° F., 80.5
40	Castor Oil	Pour Point—65° F.
32.5	Tetrahydrofurfuryl Alcohol	
2.5	Corrosion Inhibitor	
30	2, 4-Mimethylsulfolane	S.U. Vis./100° F., 62.8
10	Castor Oil	Pour Point < −65° F.
32.5	Diacetone Glycol	
25	Propylene Glycol	
2.5	Corrosion Inhibitor	

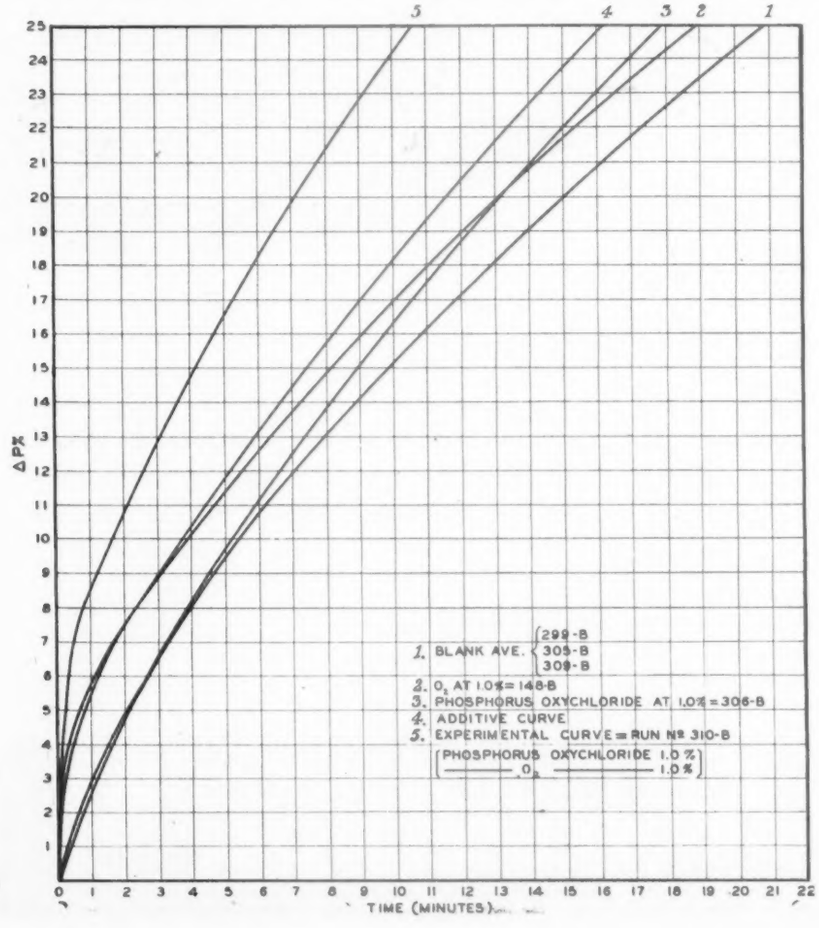

Fig. 3—Curve of percent increase in pressure versus time in cracking n-butane at 525° C. with addition of oxygen and phosphorus oxychloride. (U. S. Patent 2,399,174)

Algaecides

Cooling towers and other industrial apparatus are often plagued by growth of algae, which tend to plug up lines and to impair heat transfer. Copper salts are often employed to eliminate this trouble, but the ineffectiveness of copper salts, per se, as algaecides in alkaline waters is due to precipitation of copper as insoluble copper hydroxide. The toxic copper ion is thereby rendered inactive.

Gelfand has discovered (in his U. S. 2,400,863) that by associating aliphatic hydroxy acids or their derivatives with a water soluble inorganic copper salt the copper is prevented from being precipitated in alkaline waters, and, therefore, substantially all of the toxic copper ions remain in solution. Fig. 2 shows

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Lubricating Oil Additives (*By G. G. Pritzker*)

A reprint in booklet form of a series of three articles which recently appeared in NPN'S TECHNICAL SECTION. Reviewing the patent literature on the use of sulfur and sulfur compounds as addition agents, the first article discusses sulfonic derivatives as lubricating additives; the second, sulfur and sulfur chloride organic reaction products; the third phosphorus sulfide organic reaction products . . 24 pages, 25c

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Patent Trends

how much of the different acids are required to stabilize the copper ions.

In actual use, there is a daily loss of copper due to reaction between algae and the copper. This, of course, cannot be avoided.

Cracking

Some Pure Oil Co. results reported in U. S. 2,399,174 show that it is possible to accelerate the cracking reaction considerably by the addition of certain materials to the feed stock. Both oxygen and phosphorus oxychloride act as cracking catalysts, but the use of both reagents gives more than an additive effect.

This is illustrated in Fig. 3, in which Curve 1 is a curve of percent increase in pressure versus time in the cracking of butane. Curve 2 shows the effect of 1% oxygen added to the butane cracked, while Curve 3 is the effect of 1% phosphorus oxychloride. The additive curve for both effects would be illustrated by Curve 4. Yet, the actual data show that the effect of a combination of both catalysts is much greater than the additive effect, and is illustrated by Curve 5.

The effect is more pronounced at 5-12.5% pressure increase, the effect decreasing with increase in amount of cracking.

Selected Patents of the Month

U.S. 2,398,242 (Cities Service)—Paint and varnish remover.
U.S. 2,398,253 (Std. Oil Development)—Sulfides of alkyl phenols.
U.S. 2,398,271 (Std. Oil Development)—Sulfurized lube oil additive.
U.S. 2,398,280 (Texas)—Cracking.
U.S. 2,398,281-2 (Ethyl Corp.)—Antiknock agents.
U.S. 2,398,301 (Dow Chem.)—Purifying diolefins.
U.S. 2,398,334 (Socony)—Level indicator for granular material.
U.S. 2,398,773 (Std. Oil Development)—B-F containing alumina cracking catalyst.
U.S. 2,398,807 (S.O. Ohio)—Fractional distillation apparatus.
U.S. 2,398,819 (Texas)—Conversion with AlF_3 catalyst.
U.S. 2,398,825 (Filtrol Corp.)—Acid activated clay.
U.S. 2,398,869 (S.O. Indiana)—Alkylation.
U.S. 2,398,899 (Sinclair Refg.) — Amination catalyst.
U.S. 2,398,905 (Universal Oil Prods.)—Alkylation.
U.S. 2,398,908 (Standard Catalytic) — Polymerization-alkylation.
U.S. 2,398,919 (Union Oil)—Catalytic desulfurization.
U.S. 2,398,930 (Filtrol Corp.) — Separating diolefins.
U.S. 2,399,192 (Metal Hyd ides)—Dehydration of transformer oil with hydrides.
U.S. 2,399,224 (Universal Oil Prods.)—Hydrocarbon conversion.
U.S. 2,399,240 (Shell)—Alkylation.
U.S. 2,399,243 (S.O. Ohio)—S-P additive to lubes.
U.S. 2,399,353 & 68 (Phillips)—Alkylation.
U.S. 2,399,354 (Socony)—Isomerization.
U.S. 2,399,413 (Shell)—Aviation gasoline containing hydrindene.

Patent Trends

U.S. 2,399,464-5 (Gulf)—Dust laying composition.
U.S. 2,399,488 (Shell)—Halogenation of unsaturates.
U.S. 2,399,496 (Phillips)—Desulfurization.
U.S. 2,399,510 (Gulf)—Steam turbine oils.
U.S. 2,399,512 (Universal Oil Prods.)—Halogenated hydrocarbons.
U.S. 2,399,521 (Tide Water)—Wax compositions.
U.S. 2,399,560 (Std. Oil Development)—Olefins and diolefins.
U.S. 2,400,075 (Texas) — Cat. cracking with acid treated Doucil impregnated with Nickel. *Doucil* is a synthetic gel having the composition $Na_2O \cdot Al_2O_3 \cdot 5SiO_2$.
U.S. 2,400,090 (Phillips Petr.)—Isomerization.
U.S. 2,400,129 (Std. Oil Development)—Solution polymerization.
U.S. 2,400,176 (S.O. Indiana) — Improving temperature control in powdered catalyst system by adding to catalyst at least 25% of finely divided material of high specific heat.
U.S. 2,400,298 (Shell)—Acid treating viscous oils.
U.S. 2,400,340 & 50 & 76 (Std. Oil Development)—Separating olefins.
U.S. 2,400,355 & 63 & 73 (Std. Oil Development)—Toluene.
U.S. 2,400,367 (Standard Oil Development)—Alkylation.
U.S. 2,400,379 (Kendall Co.)—Resin impregnated textile.
U.S. 2,400,383 (duPont)—Tetraethyl lead.
U.S. 2,400,386 (Socony)—HF alkylation.
U.S. 2,400,431 (Shell) — Extracting cyanides from catalytically cracked gasoline.
U.S. 2,400,437 (Kellogg)—Alkylation.
U.S. 2,400,446 (Texas)—Cat. conversion with AlF_3 hemihydrate.
U.S. 2,400,465 (Socony)—Description of spheroidal gel particles not over 25 mm. diameter.
U.S. 2,400,874-5 (S.O. Ohio)—Fluoride catalyst recovery.
U.S. 2,400,915 (General Motors)—Diesel fuel containing less than 0.02% TEL.
U.S. 2,400,940 (McCullum) — Hydrogen detector in gases.
U.S. 2,400,959 (Iowa State College)—Hydrogenation and dehydrogenation catalyst.
U.S. 2,400,985-6 (S.O. Indiana) — Desalting crudes.
U.S. 2,401,104 (Socony)—Plastic oxy-aromatic petroleum wax.
U.S. 2,401,114 (Phillips Petr.)—Separating diolefins.
U.S. 2,401,225 (Socony)—Authraquinone.
U.S. 2,401,242 (Phillips Petr.)—Isomerization.
U.S. 2,401,246 (American Cyanamid) — Supported oxide catalysts.
U.S. 2,401,267-9 (Socony)—Nitrolic acid and pseudonitroles.
U.S. 2,401,282 (Phillips Petr.)—Separating cyclopentene from piperylene.
Can. 434,776 (Union Oil)—Alkylation.
Can. 433,723 (Texaco)—Catalytic conversion.
Can. 433,717 (S.O. Ohio) — Hydrous gel catalysts.
Br. Appl. 3397/44 (Shell) — Lithium soap greases.
Br. Appl. 11,294-5/46 (Anglo-Iranian) —p-Xylene.
Br. Appl. 11,473/46 (Universal Oil Prods.)—Carbonyl compounds.
Br. Appl. 5786/46 (Ethyl Corp.)—Antiknock agents.
Br. Appl. 11,339/46 (Shell)—Lubricants.
Can. 434,920 (Union Oil)—Grease stick.
Br. Appl. 12,289/46 (Std. Oil Development)—Ethylene.
Br. Appl. 12,290/46 (Std. Oil Development)—Styrene copolymers.
Br. Appl. 12,870/46 (Std. Oil Development)—Styrene resins.
Br. Appl. 12,501-2/46 (Distillers Co.)—Olefins.
Br. Appl. 12,642/46 (Imperial Chemical Indus.)—Ethylene.
Br. Appl. 12,661-4 (Socony)—Hydrocarbons.
Br. Appl. 24,036-7/45 (Nat'l Aluminate) — Aqueous sols of hydrous oxides.
Br. Appl. 17,688/43 (Sharples Chem.)—Polymers and copolymers of diolefins.
Br. Appl. 22,219/45 (Phillips Petr.) — Carbon black.
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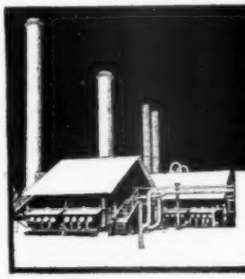

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Principles of Reactor Design

Article No. 3—DEHYDROGENATION OF NORMAL BUTANE

By R. H. Dodd and K. M. Watson

University of Wisconsin, Madison*

A small pilot plant was designed and built for the engineering analysis of catalytic processes. The design permits operation over wide ranges of conditions on a variety of systems employing solid catalysts. Operation can be either as an "integral reactor," to simulate the results of a commercial reactor, or as a "differential reactor" for the direct determination of absolute reaction rates. Such equipment, coupled with sound thermodynamic and kinetic principles, permits the establishment of optimum process conditions from a relatively few small scale experiments. It is believed that in many cases the usual period of pilot-plant and semi-commercial experimentation may be omitted and optimum large scale equipment designed directly from fundamental kinetic measurements.

Operability of the equipment was demonstrated by a short study of the dehydrogenation of butane over a chromia-alumina catalyst. It is indicated that the rate of dehydrogenation is controlled by a surface reaction involving dual active centers. The overall selectivity of the reaction is reduced by the cracking of both butane and butenes.

On the basis of these results and data from the literature, simplified equations are developed which permit partial prediction of the results of commercial reactors over wide ranges of conditions. These equations are integrated for isobaric, iso-thermal reactors to show the variation of conversion and selectivity with temperature, pressure and space velocity. More data are needed for a complete and rigorous analysis.

IN ORDER to arrive at the optimum process specifications for a catalytic reactor, knowledge is necessary regarding the effects of the process variables on both conversion and product distribution. The important variables generally include temperature, pressure, the proportions of reactants and products, and the presence of diluents or contaminants in the feed. Particularly in organic reactions the resulting overall relationships may be very complex.

Direct experimental investigation of all the possibly important combinations of variables in such a system frequently requires pilot plant operations extending over many years. Even after such a program it is difficult to translate the results to the design of large scale equipment because of the changes in mass velocities, temperature- and pressure-differentials, and surface-volume ratios which are generally inherent to change of the scale of operation. As a result, improvement merely by better selection of operating variables may continue for years after the first commercialization of a process.

The complex behavior exhibited by many catalytic processes results from the simultaneous occurrence of several different reactions, each of which bears different relationships to the primary variables. Thus, a most complicated series of overall relationships may result from the combination of steps each of which, when considered individually, follows simple fundamental laws.

It has been pointed out[5] that where sufficiently accurate paratus and technique whereby process development may be expedited by establishing fundamental kinetic relationships for each of the important individual reactions involved in a complex process. In conjunction with sound kinetic and thermodynamic theory it is possible to evaluate a fundamental rate equation for any isolated reaction from only a few rate measurements at properly selected conditions. By first studying those reactions which can be isolated, their effects may be calculated for the analysis of data in which two or more reactions are involved. In this manner the individual contributions of reactions which cannot be isolated are evaluated by difference and their rate equations developed. Thus, by starting with studies of the terminal reactions and working back toward progressively more complex combinations of reactions, it is possible to evaluate completely the individual contributions of each step in even very complex systems. Once a sound fundamental rate equation is developed for each important step the conversion and product distribution produced by any proposed reactor design may be calculated by a straightforward integration. In this manner the effects of operating variables on overall results may be explored and an optimum design arrived at entirely by calculation. These predictions can then be verified by a few pilot plant tests at the proposed conditions.

The dehydrogenation of butane over a commercial chromia-alumina catalyst was selected as the system for study because of its importance in the synthetic rubber and aviation gasoline programs. It has the advantage of being a relatively simple system and yet is sufficiently complex to fully test the proposed methods.

It has been pointed out[5] that where sufficiently accurate methods of chemical analysis are available kinetic data are best established by direct rate measurements in a "differential reacter" which may be operated to simulate conditions in a short section of a commercial reactor. By use of this method it is possible to operate laboratory equipment with mass velocities comparable to those in commercial plants. A reaction rate may be calculated from each experimental run if the changes in composition are sufficiently small to permit the assumption that the arithmetic or logarithmic mean of the terminal conditions satisfactorily represents the average conditions of the reactor.

Operation of a differential reactor requires equipment for feeding to the reactor mixtures of reactants, products, and diluents in the proportions in which they may occur at any differential cross-section of a commercial reactor. This may be accomplished by providing for the simultaneous feeding of one gaseous stream and one or more liquid streams to the experimental reactor. The desired feed compositions are then obtained by varying the compositions of the individual streams and the proportions in which they are fed.

Direct determination of reaction rates in a differential reactor is not feasible where the methods of chemical analysis are not sufficiently precise to evaluate the small changes in composition which are produced. Further difficulty is encountered if in a complex organic reaction there are formed by-products of uncertain composition, such as heavy polymers. It is often difficult to properly take such materials into account in the feed to a differential reactor. Where for any of these reasons differential operation is not feasible, it is necessary to resort to "integral conversion" data for the establishment of kinetic relation-

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ships. Unless the reaction is sufficiently simple to permit development of an integrated conversion equation, it is necessary to make a series of integral conversion runs at varying space velocities in order to establish one differential reaction rate by graphical differentiation.

The experimental equipment was designed to permit either differential or integral operation. In the case of butane dehydrogenation differential operations would require feeding a gas stream, largely hydrogen, to the reactor. Such a feed system was provided but was not used, since only integral conversion tests were carried out.

Reactions in n-Butane Dehydrogenation

The principal reaction in the catalytic processing of butane over chromia-alumina catalysts is the direct catalytic dehydrogenation to butenes. Thus:

1. $nC_4H_{10} \rightleftarrows C_4H_8 + H_2$ (catalytic)

Secondary catalytic dehydrogenation to butadiene also takes place:

2. $C_4H_8 \rightleftarrows C_4H_6 + H_2$ (catalytic)

Reactions 1 and 2 occur largely as a result of the presence of the catalyst and are presumed to take place on its surfaces. However, some additional dehydrogenation occurs through uncatalyzed pyrolysis in the void spaces of the catalyst bed and in the preheater and transfer spaces at the inlet and outlet of the reactor. Since pyrolytic dehydrogenation reactions depend on quite different factors they should be separately considered. Their relative importance depends on the activity of the catalyst; with poor or nearly spent catalysts they may be of considerable significance. Accordingly, Reactions 1a and 2a may be designated as the pyrolytic counterparts of (1) and (2)

1a. $C_4H_{10} \rightleftarrows C_4H_8 + H_2$ (pyrolytic)

2a. $C_4H_8 \rightleftarrows C_4H_6 + H_2$ (pyrolytic)

In addition to these principal desired reactions there are important side reactions which result in the destruction of butane, butenes, or butadiene to form undesired products. These reactions may be classified as of the dealkylation or "cracking" and the polymerization types and may occur either through catalytic action or as a result of uncatalyzed pyrolysis in the void spaces of the catalyst bed or in the preheater and transfer spaces. The principal reactions to be considered are:

3. The dealkylation of butane to form methane, ethane, ethylene, propylene.

4. The dealkylation of butenes to form methane, ethane, propane, ethylene, propylene, and carbon.

5. The dimerization of butadiene to form 4-vinyl cyclohexene-1.

6. The decomposition of butadiene to form hydrogen, methane, ethylene, acetylenes and carbon.

In addition there are many other reactions which probably occur to limited extents but are negligible under the conditions ordinarily contemplated for the dehydrogenation of butane. Such reactions are the polymerization of butenes and the other olefins formed as dealkylation products. A limited amount of dehydrogenation of butadiene to vinyl acetylene also probably occurs, followed by further reactions of this product.

A complete kinetic analysis of the system should include measurements of the rates of all of these reactions, both catalyzed and uncatalyzed, from which rate equations can be developed. However, for many purposes it is possible to neglect some of the reactions and consider others as combined with each other. Simplified analyses of this type are particularly useful for preliminary design studies which later may be refined by more extensive measurements.

Because of war-time conditions it was necessary to terminate this experimental project before sufficient data were gathered for a complete evaluation of the secondary reactions. However, an informative analysis was developed by neglecting the conversion of butenes to butadiene and considering only three reactions, the dehydrogenation of butane, the dealkylation of butane and the dealkylation of butenes. With more complete data, the production and reactions of butadiene should be considered, particularly at low operating pressures, and all of the reactions should be resolved into catalytic and pyrolytic contributions by experimental runs in which a non-catalytic bed of fused quartz granules is substituted for the catalyst.

Apparatus

For fundamental studies of catalytic reactions it is desirable that the catalyst bed be in a reactor so designed that its temperature and pressure can be accurately controlled to substantially isothermal and isobaric conditions. For high-temperature reactions it is important that the void spaces outside the catalyst bed be reduced to a minimum in order to avoid excessive uncatalyzed reactions. In order to permit investigation of wide ranges of space velocities it is also desirable that the volume of the catalyst bed may be varied without seriously changing the ratio of void spaces to mass of catalyst. The reactor which was designed to meet these requirements is shown in diagrammatic cross-section in Fig. 1.

The reactor tube is a 1-in. standard pipe of 27% chrome steel, 48 in. in length, which is screwed into a bolted flange at each end. The upper portion of this tube is surrounded by a thermostatic block of aluminum bronze, 4¾ in. in diameter and 39 in. long. This block is heated by electrical resistor elements which are divided in two sections to permit separate control of the heat input to the upper third and the lower two-thirds of the block. A detailed description of this thermostatic block and its temperature controls is given by Anderson and Rowe[1]. It may be operated at temperatures ranging from atmospheric to 1200° F.

In order to arrest reactions in the material leaving the catalyst bed the lower section of the reactor tube is provided with a jacket through which water is circulated. The jacket was formed

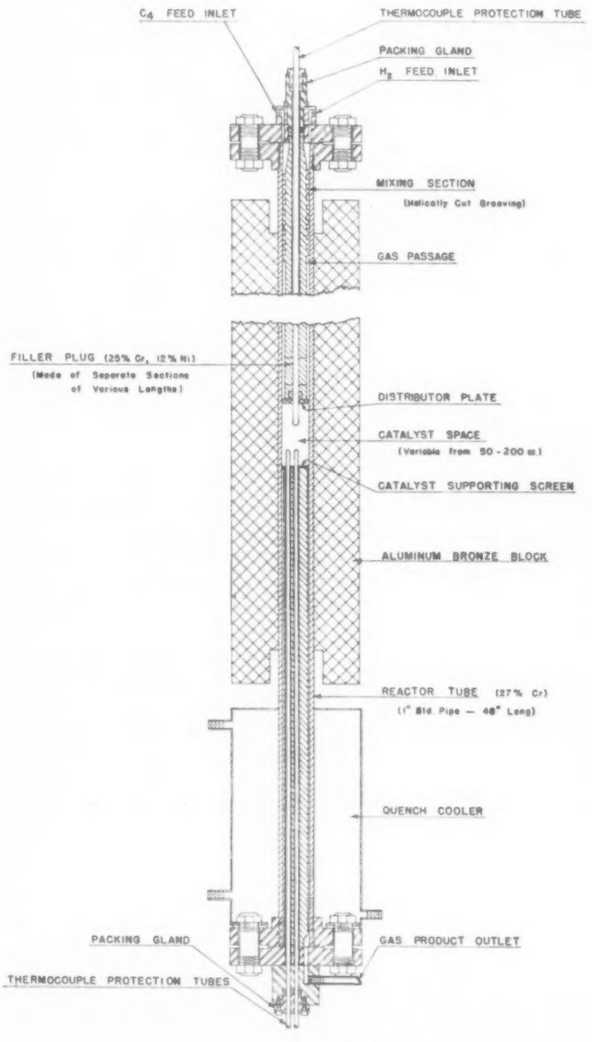
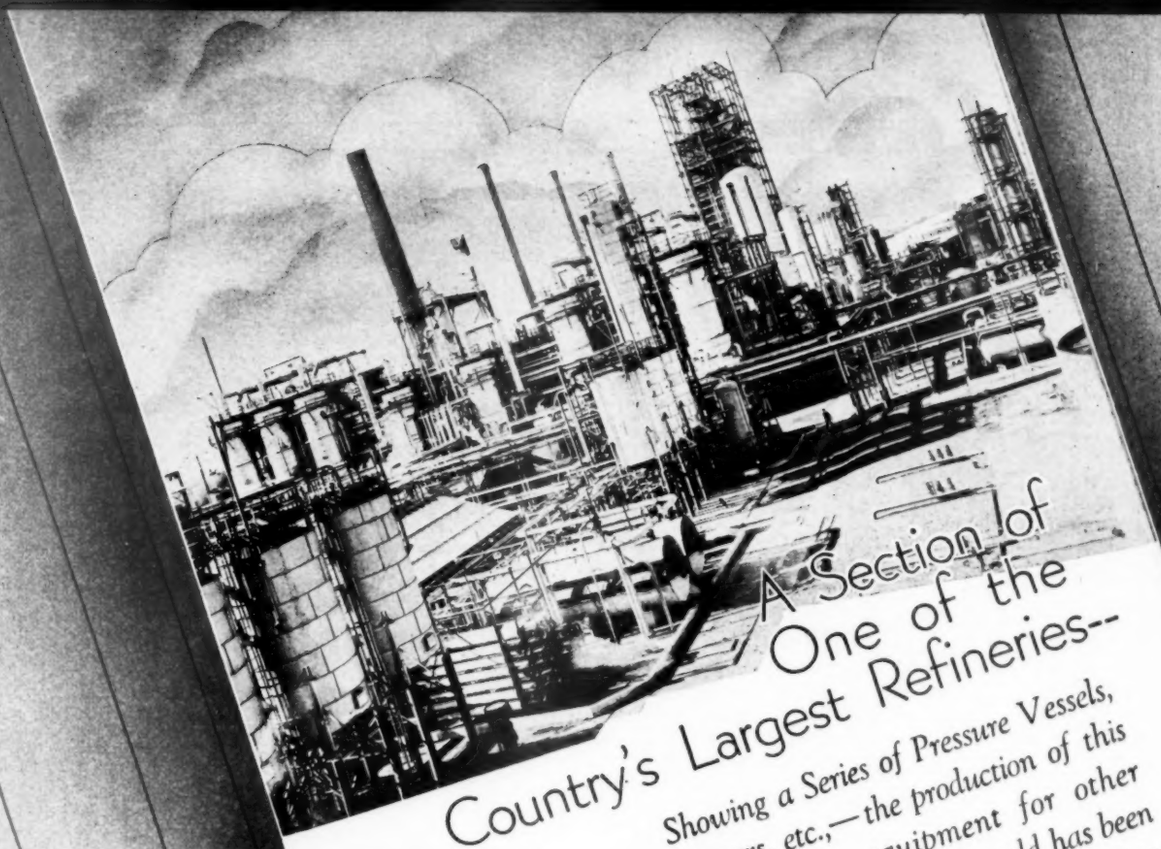


Fig. 1—Details of Reactor



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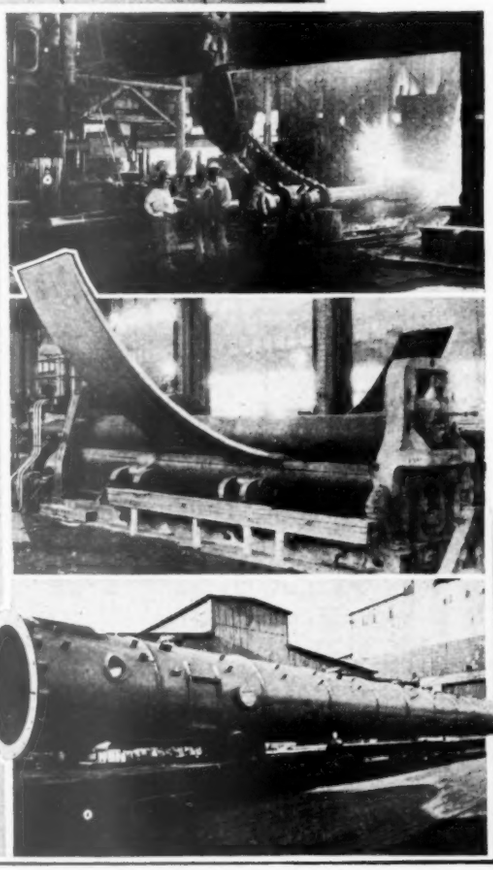

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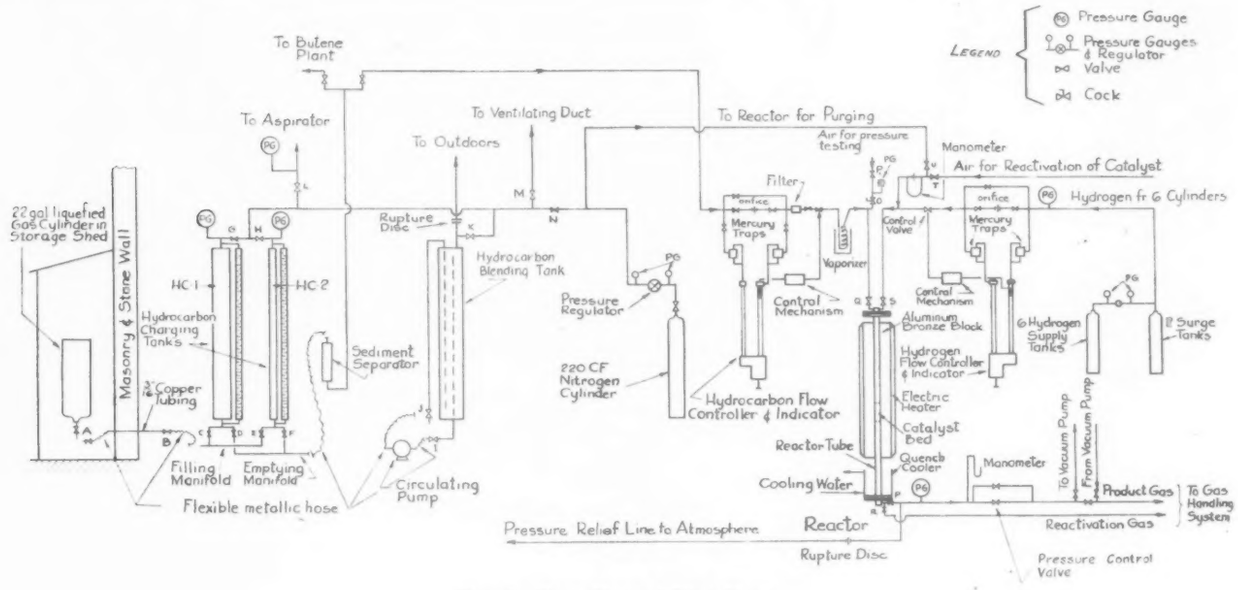

Fig. 2—Flow Plan of Pilot Plant

by brazing a cylindrical sleeve to a steel ring which fits under the bolts of the lower flange.

The catalyst bed is supported on a screen of 18% Cr, 8% Ni steel approximately 8 in. above the bottom of the aluminum bronze block. This screen rests on short pegs in the top of a filler plug having a diameter $\frac{1}{8}$ in. less than the inside diameter of the reactor tube. Thus the reaction products pass from the bed to the cooler through an annular space 1/32 in. wide. Two thermocouples in 18-8 steel protection tubes pass through this filler plug and measure the temperature of the lower section of the catalyst bed. The position of the thermocouples is made adjustable by means of a dual packing gland as indicated in Fig. 1.

The top of the reactor tube is provided with two inlets, one for liquid C_4 hydrocarbons and one for hydrogen in the butane dehydrogenation studies. In order to ensure complete mixing and vaporization of the feed streams, the upper section of the reactor tube is provided with a close-fitting filler-plug in which is cut a square helical groove. The filler plug is made of 25% Cr, 12% Ni steel, which has a higher coefficient of thermal expansion than the 27% Cr tube. The diameter of the grooved section of the plug is such that at 1200° F. there is no clearance between the tube and the lands of the plug. Thus at high temperature the feed is forced to follow the spiral path of the grooves but cooling frees the plug so that it can be removed.

Below the helically grooved mixing and vaporizing section is a preheater, in the form of an annular space $\frac{1}{8}$ in. wide around the central filler plug. This portion of the plug is in sections of various lengths which are fastened to each other by loose-fitting threads. By using different combinations of these plug sections, the free space for the catalyst bed may be varied from 50 to 200 cc. A single thermowell passes through a packing gland and the upper filler plug into the top of the catalyst bed.

In order to minimize channelling down the edges of the catalyst bed the bottom section of the upper filler plug is provided with a perforated distributor plate. This plate fits closely against the reactor tube walls and serves to direct the stream from the annular preheater to the center of the tube.

Flow Plan. The flow plan of the pilot plant as arranged for butane dehydrogenation is shown in Fig. 2. Cylinders of butane, butenes, and butadiene are stored in the inverted position in a shed which is thermostatically controlled at a temperature of 100° F. Liquid hydrocarbon from any of these cylinders may be transferred through a copper line leading to a blending tank in the pilot plant room. As a result of the difference in vapor pressure resulting from the temperature difference no pump is required for this transfer. In order to avoid the possibility of undetected leakage and mixing of stocks, flexible metallic hose sections are used to interconnect the storage, blending, and charging tanks. In this manner many valves and manifolds are eliminated.

A hydrocarbon feed of the desired composition is prepared in the blending tank, which is provided with reflex type gage glasses over its entire length. Uniform composition is ensured by circulating for several hours by a rotary pump. This same pump is used to transfer feed from the blending tank to the accurately calibrated charging tanks. Tanks of two sizes are provided for different rates of flow.

The hydrocarbon charging tanks are held at a pressure approximately 50 psi above the operating pressure of the reactor by means of nitrogen supplied through a conventional spring loaded pressure regulating valve. This method of feeding from pressured cylinders was adopted in preference to a pump because of the difficulty generally experienced when attempting to pump small streams of light hydrocarbons.

The hydrocarbon feed rate is indicated and controlled in the liquid phase by a mercury manometer which measures the pressure differential across a glass capillary in a steel housing of the type described by Anderson and Rowe.[1] The manometer operates an electrically driven needle valve. A vaporizing coil in a hot water bath is located at the outlet of the control valve to prevent the accumulation of liquid hydrocarbons in the low pressure lines.

Provisions are made for feeding hydrogen from cylinders to the inlet of the reactor. The flow of hydrogen is indicated and controlled by a manometer and electrically driven needle valve similar to that used for the hydrocarbon.

The catalyst must be periodically regenerated by oxidizing the carbonaceous deposit formed during processing. This is accomplished by introducing air at a rate indicated by a manometer and controlled by a manually operated valve. The rate of air introduction is kept low to avoid temperatures in excess of 1200° F. in the catalyst as the burning progresses downward through the bed.

At the outlet of the reactor tube two lines are provided, one for the product gases and the other for regeneration gases. The process pressure is controlled by a manually operated needle valve. Regenerations are carried out at atmospheric pressure. A Kinney vacuum pump is provided for low-pressure processing.

Temperatures in the aluminum bronze block surrounding the reactor are controlled by contacts which are actuated by the differential expansion of silica rods in holes drilled in the block. This arrangement is described by Anderson and Rowe.[1] Temperatures of the block and the catalyst bed are recorded on a six-point potentiometer.

Gas Handling Equipment. The process gases are passed through a water saturator which is filled with rings and then to two wet test meters which are connected in parallel. The

shafts of these two meters are connected together by means of chains and sprockets through a countershaft. By suitable selection of sprockets the relative rates of rotation of the two meters can be fixed at any desired ratio. The main stream of product gases passes through the large meter, which has a displacement of either 1/10 or 1/5 cu. ft. per revolution. The smaller meter has a displacement of 1/20 cu. ft. per revolution and is used for obtaining a metered and representative sample. With the two meters chained together the sample is taken at a rate which is at all times proportional to the rate of gas production if the pressure differentials across the two meters are so adjusted that neither can blow its water seal. This is accomplished by permitting the large meter to discharge through a large line at atmospheric pressure and providing a water-seal pressure regulator at the outlet of the small meter. This regulator is designed to handle a vacuum of 2 in. of mercury from the sample collecting system and hold the pressure at the meter outlet at any desired point within 3 in. of water above or below atmospheric. Regulation within approximately ⅛ in. of water is obtained. An unbalance of approximately ½ in. of water is permissible without affecting the seals of the wet test meters. The control pressure is varied by changing the water level in the regulator vessel.

The gas from the pressure regulator passes through a trap and drying train into a condenser and trap which are cooled by a dry ice-acetone bath. In this trap substantially all C_4 hydrocarbons are condensed along with some C_3 and C_2 constituents. The lighter gases pass through into a 5-gal. bottle where they are collected and measured over brine. A water-jet aspirator maintains a vacuum on the brine receiver bottle. This vacuum is limited to 2 in. of mercury by a mercury seal which introduces air at lower pressures.

The noncondensable gases are analyzed by absorption and combustion in a conventional Bureau of Mines type gas analysis apparatus. It is planned to analyze the condensed portion of the gases by low temperature fractional distillation followed by determination of the composition of the C_4 fraction by infra red and ultraviolet spectrophotometry. However, in the preliminary runs here reported the condensed gas was merely vaporized, measured, and analyzed for total unsaturates by measuring the reduction in volume accompanying treatment with acid mercuric nitrate solution. Low temperature distillations of selected samples indicate that little error is involved in assuming that the condensed gases are all C_4 compounds when dehydrogenating pure *n*-butane at moderate conversions with a good catalyst.

The regeneration gases are passed through a copper oxide tube at 600° F. to insure complete oxidation of any CO formed. The CO_2 is determined by bubbling the entire gas stream through a wash bottle containing standard KOH, which is titrated to determine the amount of carbon burned from the catalyst.

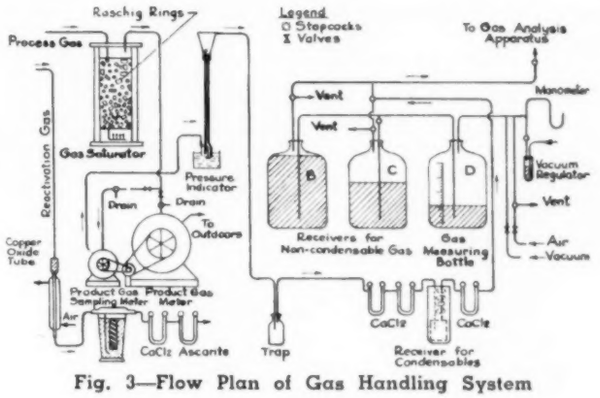

Fig. 3—Flow Plan of Gas Handling System

Experimental Data

In order to demonstrate the operability of the equipment a series of preliminary runs was made on technical grade *n*-butane which contained 3.4% isobutane and 0.2% propane. The catalyst was supplied by the Phillips Petroleum Co. as representative of that used in their commercial butane dehydrogenation operations. It was in the form of ⅛ in. by ⅛ in. cylindrical pellets. All runs were at a catalyst bed temperature of approximately 1060° F. and the processing periods were of 30-min. duration, followed by regeneration of the catalyst. The reactor was purged with nitrogen after the process period to sweep all hydrocarbons into the gas collection system. The product gas analyses were reported on the nitrogen-free basis. In most cases a single set of gas samples was collected from two duplicate process periods for each run. When a run was to be made at changed conditions a single preliminary process period was run at the new conditions to saturate the water in the meters and gas collecting system with representative gases. No samples were collected during this period which also served to stabilize the plant operation.

The data collected are summarized in Table 1. Hourly gaseous space velocities (0° C. and 760 mm.) were varied from 400 to 17,000 and reactor pressures from 1.1 to 2.7 atm. The following definitions of conversion and selectivity were used.

$$\% \text{ Conversion} = 100\,\frac{(\text{butane fed})-(\text{butane in product})}{\text{butane fed}}$$

$$\% \text{ Selectivity} = 100\,\frac{\text{moles butenes in product}}{(\text{moles butane fed})-(\text{moles butane in product})}$$

It should be noted that the method of analysis employed includes butadiene with the butenes. Thus, the reported number of moles of butenes in the product is actually the number of moles of butenes plus butadiene. No error results from this source in calculating the conversion but the calculated butene

TABLE 1—Summary of Experimental Data
Catalyst: Vol. = 50 cc.; Wt. = 53.68 gms.

Process Period Nos.	12*a,b*	12*c,d*	14*y,z*	15*s,t*	16*b,c*	16*d,e*	18*b,c*	19*b,c*	A-4	A-5	A-6	B-4	B-5	B-6
No. of Periods	2	2	2	2	2	2	2	2	1	1	1	1	1	1
Length of Periods, Mins.	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Feed														
Space Velocity, (V)/(V) (*Hr.*)	995	735	405	1300	2020	2035	2000	925	7920	7870	7910	15,820	15,780	16,750
Volume,° liters	49.8	36.8	20.3	64.9	101.1	101.7	100.0	46.3	198.1	196.8	197.7	395.6	394.5	418.7
Reactor Pressure, atm.	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.1	2.0	2.7	2.7	1.25	2.0
Reactor Temperature, °F.	1055	1055	1055	1060	1060	1055	1065	1055	1060	1055	1060	1060	1060	1065
Condensables														
Volume,° liters	45.5	32.2	18.6	61.9	99.5	99.1	99.0	44.4	197.5	195.6	196.4	394.5	394.2	417.7
Analysis, mole—%														
Butenes	30.2	30.6	42.7	26.0	24.1	24.1	30.9	31.8	8.5	10.5	9.5	5.5	4.5	4.2
Butanes	69.8	69.4	57.3	74.0	75.9	75.9	69.1	68.2	91.5	89.5	90.5	94.5	95.5	95.8
Non-Condensables														
Volume,° liters	32.9	27.0	10.3	24.2	25.9	36.8	20.9	18.2	13.8	18.6	14.5	16.4	7.1	11.9
Analysis, mole—%														
CO_2	...	...	0.2	..	..	..	0.6	1.8	0.3	0.1	0.5	1.0	...	...
Olefins	..	..	4.3	..	0.1	..	0.6	1.2	0.5	0.7	0.6	.	0.4	.
H_2	77.5	72.0	66.4	76.9	86.0	85.4	85.1	78.1	88.3	85.0	79.3	81.6	81.6	81.3
CO	4.4	4.6	6.1	4.9	1.7	1.7	2.0	1.6	1.1	0.9	1.1	1.4	1.5	1.5
Paraffins	18.1	23.4	23.0	18.2	12.2	12.9	11.7	17.3	9.8	13.3	18.5	16.0	16.5	17.2
Coke, gms.	1.48	1.45	0.65	0.43	0.64	0.82	0.59	0.69	0.28	0.40	0.35	0.26	0.16	0.32
Conversion	36.2	39.0	47.3	29.2	25.1	25.9	31.4	34.5	8.6	11.0	9.9	5.6	4.4	4.2
Selectivity	76.3	68.8	82.7	85.0	94.6	90.7	97.6	88.3	98.4	94.9	96.0	98.7	102.9	99.5

°Measured at 0° C. and 760 mm.

selectivities are always too high by the number of moles of butadiene produced per mole of butane decomposed. The reported selectivities are thus intermediate between the true butene selectivities and the selectivities which would have been obtained if no secondary dehydrogenation had occurred. The experimental runs were conducted at conditions of relatively low temperature and high pressures to minimize butadiene formation. Under these conditions the butadiene is probably less than 5% of the total conversion except at the lowest space velocities.

Examination of Table 1 will reveal that the data are not all consistent and do not yield satisfactory element balances, even though the overall weight balance error was generally less than 5%. Particular difficulty was experienced with both the measurement and analysis of the net non-condensable gases as a result of the considerable quantities of pure nitrogen included with them. In future operations changes will be made to minimize nitrogen contamination.

Because of the poor data on the non-condensable gases the observed ratios of hydrogen to butene are not reliable, particularly in the early runs. For example, in Runs 12*a* and *b* this ratio was over 1.5. However, the average ratio for the entire series is approximately 0.9 as compared to a theoretical value somewhat over 1.0, depending on the butadiene production. No use was made of the data on the non-condensable gases in calculating conversions and selectivities.

The probable errors of the selectivity and conversion data are difficult to predict. At low conversions the selectivity approaches 100% and the conversion is approximately equal to the butene content of the condensable product. Particular care was taken in the analyses in Runs *A*-4 to *B*-6 and the errors of these conversions are probably not more than ±0.5% of the feed. At higher conversions the errors resulting from lack of fractionation in separating the condensable and non-condensable products become more serious and errors in conversion may be ±2% or more.

The selectivity results are inherently less accurate than the conversions and with the method of calculation employed are seriously affected by any losses of condensable products. As a result errors of ±5% are probable at low conversions and ±10% or more at high conversions where separation of the condensable products is less certain.

Kinetic Analysis of Process

Even though the data collected are not sufficient for a completely satisfactory analysis of the kinetics of the operation, it was considered worth while to proceed with the best analysis possible on the basis of the data obtained and that in the literature. Even though some errors are doubtless involved it is believed that this work will be useful in guiding future experimentation. It has also proved valuable in exploring the possibilities of rigorous process design.

The kinetics of catalytic reactions are discussed in detail by Hougen and Watson,[5] who have developed equations corresponding to rate control by a variety of surface reaction and adsorption mechanisms. In applying these principles to the limited data available for butane dehydrogenation the following assumptions are made:

1. Partial pressure differences resulting from diffusion of reactants and products to and from the catalyst particles are negligible. This assumption may be verified by calculating typical partial pressure differences by the method outlined by Hougen and Watson.

2. The "effectiveness factor" of the catalyst is constant for a given catalyst particle size and temperature. When working with catalyst particles of a fixed size this factor may be neglected and considered as a part of the overall rate equation constant.

3. The principal catalytic reaction proceeds at a rate which is controlled by the rate of decomposition of chemisorbed butane molecules on the surface of the catalyst and equilibrium is maintained in all activated adsorption steps. This assumption seems plausible and is indirectly supported by the evidence of Beckman, Pufahl and Hougen[2] that in the analogous catalytic hydrogenation of iso-octenes the rate controlling step is the surface reaction.

4. Butane is destroyed by dealkylation or cracking reactions which approximate the behavior of a first order homogeneous reaction, even though they are accelerated by the presence of the catalyst. It is further assumed that these cracking reactions yield the same products and have the same temperature coefficient as the non-catalytic pyrolysis of butane.

5. Butene is destroyed by cracking at the same rate as is butane under the same conditions. There is evidence in the literature[10] that this is approximately the case for the uncatalyzed pyrolysis of the two compounds.

6. The deposition of carbonaceous material on the catalyst has only a negligible effect on the average rate of reaction over the 30-min. process periods investigated.

7. Butene and hydrogen are present in the products in approximately equimolal proportions.

8. The dealkylation products of cracking butane and butenes are not appreciably adsorbed on the active centers of the catalyst.

9. The independent effects of butadiene production may be neglected.

The most questionable of these assumptions are 4 and 5. It is probable that the cracking of both butane and butenes proceed by catalytic as well as by homogeneous pyrolytic mechanisms. The rates of the catalytic reactions would be expected to be less affected by both temperature and pressure than the pyrolytic. For this reason it is probable that assumptions 4 and 5 lead to rate equations which indicate too great variations of selectivity with both temperature and pressure. The pyrolytic and catalytic effects should be separately evaluated by further experimental work.

On the basis of assumption 3, two mechanisms should be considered, leading to two alternate rate equations. The reaction might involve only a single active center or adsorption site. In this case the adsorbed butane molecule is decomposed on the site in which it adsorbed and forms one adsorbed product molecule and one in the gas phase. The rate of reaction is proportional to the number per unit area of butane molecules adsorbed on suitable active centers.

The alternate mechanism involves two adjacent active centers, one occupied by an adsorbed butane molecule and the other empty. The reaction occurs through the butane molecule forming an activated complex with the vacant active center. This complex then decomposes to form two adsorbed product molecules. The rate of reaction is proportional to the number per unit area of pairs of adsorbed molecules and adjacent active centers. Hougen and Watson[5] developed the following rate equations to correspond to these two mechanisms:

Single Site Mechanism:

$$r_{m1}=\frac{C_1\left(p_A-\frac{p_R p_S}{K}\right)}{1+p_A K_A+p_R K_R+p_S K_S+p_I K_I+\ldots+B} \quad \ldots\ldots(1)$$

Dual Site Mechanism:

$$r_{m1}=\frac{C_2\left(p_A-\frac{p_R p_S}{K}\right)}{(1+p_A K_A+p_R K_R+p_S K_S+p_I K_I+\ldots+B)^2} \quad \ldots\ldots(2)$$

where,

r_{m1} = rate of dehydrogenation of butane, (moles)/(mass of catalyst) (time)

$C_1\,C_2$ = overall rate constants which depend on the temperature, the nature of the catalyst and its particle size

$p_A,\ p_R,\ p_S$ = partial pressures of butane, butenes, and hydrogen, respectively, (atm.)

$p_I\ \ldots$ = partial pressures of inert or other constituents of the system, (atm.)

K = gas phase thermodynamic equilibrium constant = $(p_R p_S/p_A)$ at equilibrium, (atm.)

$K_A, K_R, K_S, K_I\ \ldots$ = apparent or effective adsorption equilibri-

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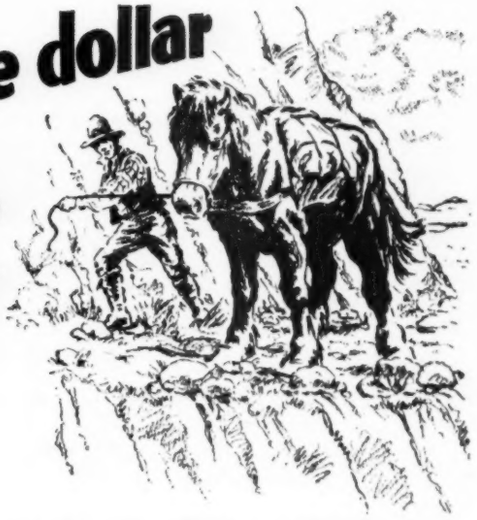

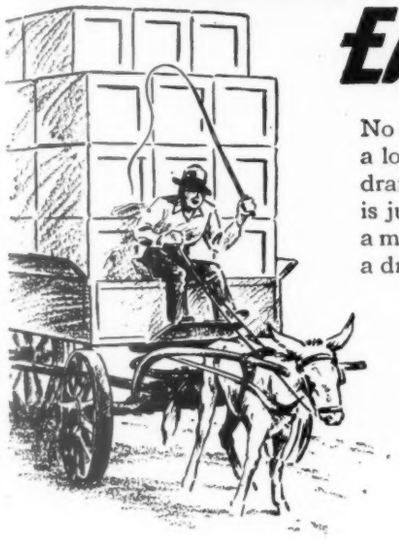

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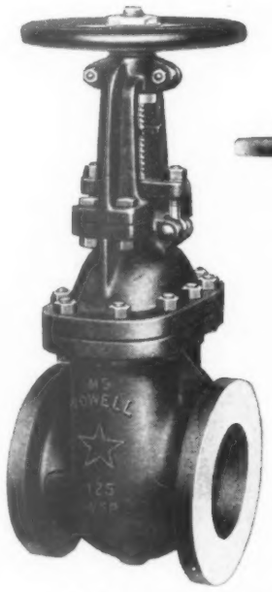

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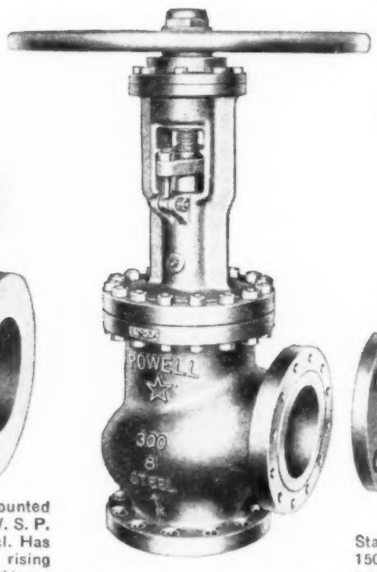

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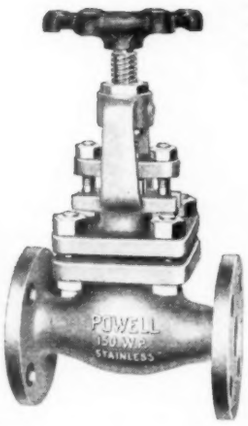

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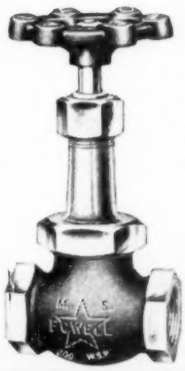

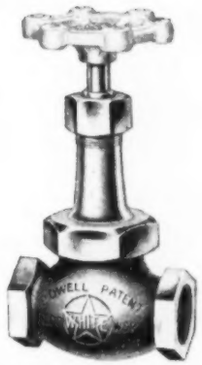

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B = a fouling factor which takes into account the covering of active centers by catalyst deposit.

The fouling factor B was not included in the equations of Hougen and Watson, who considered only non-fouling reactions. It becomes of major importance in most high temperature organic reactions in which carbonaceous deposits result from side reactions. The fouling factor is primarily a function of the length of the process period, approaching zero for short process periods. It probably also depends on temperature, pressure, and extent of conversion. It seems probable that B must be evaluated as an empirical function of these variables for each individual system. This can be done by making runs of different process period lengths or by taking samples at frequent intervals during each run over a long process period. As previously pointed out, the fouling factor is neglected for the 30-min. process periods considered in this analysis.

On the basis of assumptions 4 and 5, the rate of cracking of either butane or butenes is represented by the following equation:

$$r_{m2} = k_2 p_B \quad (3)$$

where,

r_{m2} = rate of cracking of butane and butene, (moles)/(mass of catalyst) (time)

p_B = partial pressure of butane plus butene (atm.)

Evaluation of Cracking Constant. On the basis of the assumptions made, deviation of the overall selectivity from 100% results only from the cracking of butane or butenes. Thus,

$$(100 - Y)/100 = x_d/x_t \quad (4)$$

where,

Y = percentage selectivity, or ultimate yield, moles of butenes per 100 moles of butane decomposed

x_d = moles of butane and butenes cracked to dealkylation products per mole of butane fed

x_t = total conversion, moles of butane decomposed by both dehydrogenation and dealkylation reactions per mole of butane fed.

By means of Equation 4 values of x_d were calculated from the selectivity and conversion data of Table 1.

In any incremental cross-section of the catalyst bed which contains a mass of catalyst dW, the following material balance may be written for the amount of dealkylation occurring per unit time in steady flow operation if longitudinal diffusion is neglected:

$$r_{m2} dW = F dx_d$$

or, since F is constant,

$$r_{m2} = dx_d/d(W/F) \quad (5)$$

where,

W = mass of catalyst

F = butane feed rate, (moles)/(time)

r_{m2} = rate of cracking reactions, (moles)/(mass of catalyst) (time)

If Equation 5 is written in the integrated form $W/F = \int dx_d/r_{m2}$, it is evident that a relationship between x_d and W/F is established throughout any reactor operating at steady-state conditions. At constant conditions of temperature, pressure, and feed composition, r_{m2} is a function only of x_d if diffusional effects are negligible. Under such conditions the relationship between x_d and W/F is independent of reactor shape, size, or feed rate and W/F may be varied by varying the feed rate to a catalyst bed of fixed weight with the same result as if the depth of catalyst bed were varied with a fixed feed rate. Thus, if values of x_d are plotted as ordinates against W/F the slope of the curve at any point represents r_{m2}, the rate of dealkylation reactions. The effective reaction velocity constant k_2 may then be calculated by rearranging Equation 2,

$$k_2 = \frac{r_{m2}}{p_B} = \frac{r_{m2} n_t}{(1 - x_d)\pi} \quad (6)$$

where,

n_t = total number of gaseous moles present per mole of butane fed

π = total pressure (atm.)

By applying Equations 3-6 to the data of Table 1 at 1.3 atm. it is theoretically possible to arrive at a series of values for k_2 by graphical differentiation. However, in view of the scattering of the selectivity data this procedure is not accurate because of the latitude in drawing curves to represent the experimental points. The results of graphical differentiation are extremely sensitive to changes in the shapes of curves and in general the method is useful only for establishing first approximations to the constants of rate equations. The constants are then adjusted by trial integrations until satisfactory agreement is obtained between the calculated integral conversion curves and the data. In this manner the following value of k_2 was arrived at:

k_2 (1060° F.) = 0.002 (moles)/(mass of catalyst) (hr.) (atm.) (7)

This value is confirmed by the agreement between the calculated and experimental selectivity values shown in Fig. 7. Comparison of Equations 3 and 7 with the data in the literature[10] for the uncatalyzed pyrolysis of butane indicates that the presence of the catalyst increases the rate of cracking by a factor of 5-10.

Determination of Catalytic Mechanism. Choice between Equations 1 and 2 and evaluation of C and K_A is best based on data from runs at high space velocities and varying pressures. At infinite space velocity, corresponding to zero conversion, these equations reduce to the following for a pure butane feed:

$$r_{m1} = \frac{C_1 p_A}{1 + p_A K_A} \quad (8)$$

$$r_{m1} = \frac{C_2 p_A}{(1 + p_A K_A)^2} \quad (9)$$

An equation similar to 5 may be written for the total conversion of butane. Thus:

$$r_{m3} = dx_t/d(W/F) \quad (10)$$

where,

r_{m3} = rate of decomposition of *butane* by both dehydrogenation and dealkylation reactions, (moles)/(mass of catalyst) (time)

x_t = moles of butane decomposed per mole of butane fed.

Graphical differentiation of a curve relating x_t to W/F gives values of r_{m3} from Equation 10. Corresponding values of r_{m1}, the rate of catalytic dehydrogenation, are obtained by subtracting the rate of cracking of *butane* calculated from Equations 3 and 7. From data at high space velocities the x_t vs. W/F curve may be extrapolated to zero and the initial rates determined. As was previously pointed out, particular care was exercised in obtaining reliable conversion data at high speed velocities and it is under these conditions that the errors of the entire experimental procedure are at a minimum. As a result it is felt that considerable reliance may be placed on these low-range conversion data, even though the corresponding selectivities are much less accurate and all data are somewhat erratic in the high conversion range.

In Fig. 4 are conversion curves from the high space velocity data of Table 1 at three different pressures. The slopes of these curves at the origin were estimated to obtain values of r_{m3} and the corresponding values of r_{m1} calculated. These initial catalytic rates are plotted in Fig. 5 to test the mechanism of the reaction. This plot is based on the following rearrangement of Equations 8 and 9:

$$\frac{p_A}{r_{m1}} = \frac{1}{C_1} + \frac{K_A}{C_1} p_A \quad (11)$$

$$\sqrt{\frac{p_A}{r_{m1}}} = \frac{1}{\sqrt{C_2}} + \frac{K_A}{\sqrt{C_2}} p_A \quad (12)$$

Thus, if Equation 8 is correct a plot of p_A/r_{m1} should be linear while if Equation 9 is correct a straight line should result from plotting $\sqrt{p_A/r_{m1}}$ against p_A. It is evident from Fig. 5 that the data plot best in accordance with Equations 2, 9 and 12. It is therefore assumed that the reaction proceeds by a dual site mechanism and these equations are adopted. The following

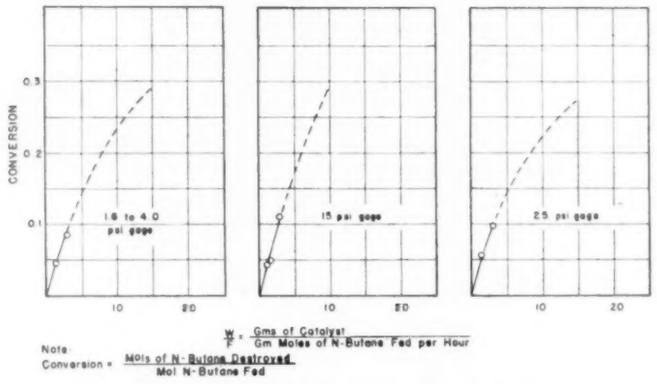

Fig. 4 (above)—Initial Reaction Rates

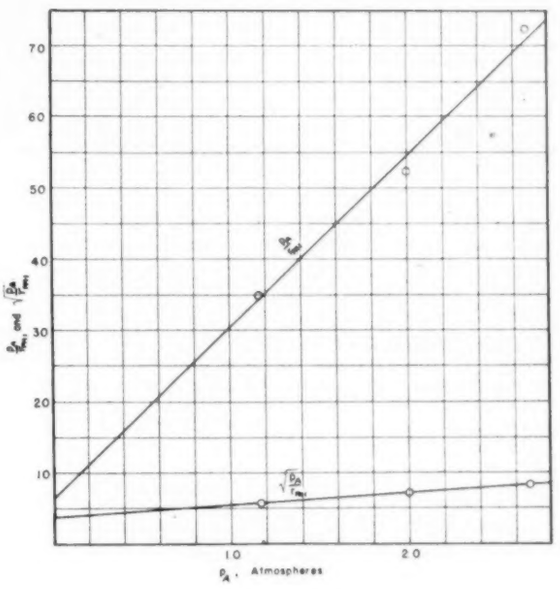

Fig. 5 (right)—Test of Equation Form

values of C_2 and K_A are obtained from the slope and intercept of the curve of Fig. 5.

C_2(1060° F.) =

0.0676 (moles)/(mass of catalyst) (hr.) (atm.) ..... (13)

K_A(1060° F.) = 0.450 1/atm. ..... (14)

Fig. 5 cannot be looked upon as a conclusive verification of the proper form of rate equation because of the small range of pressures and the relatively high experimental error. A complete test of mechanism should cover a wide range of pressure and preferably should include studies of the reverse reaction with varying proportions of reactants. However, the indicated form of rate equation appears to be consistent with the data from commercial dehydrogenation operations and is the same as that established by Beckman, Pufahl and Hougen for an analogous catlytic hydrogention reaction.

It is of interest to note that Equation 9 indicates that the initial rate of reaction passes through a maximum and then diminishes as pressure is increased.

A maximum initial rate of reaction at a pressure of approximately 2.0 atm. is indicated. Higher pressures may be looked upon as reducing the rate because the concentration of butane molecules adsorbed adjacent to vacant active centers is diminished by excessive butane adsorption. If Equation 8 were applicable the rate of reaction would progressively increase with pressure over the entire range but would approach independence of pressure at high pressure.

Overall Equilibrium Constant. The thermodynamic gas phase equilibrium constants for the dehydrogenation of *n*-butane into each of the three normal butenes were calculated from the thermodynamic data of Pitzer[8] and Rossini[9]. These results indicate that in the range of temperatures investigated the trans-butene-2 should be formed in the greatest quantity if equilibrium is approached. The numerical value of the equilibrium constant was roughly veified from the experimental data by plotting the observed ratio $p_R p_S / p_A$ against F/W and extrapolating to zero, corresponding to an infinite ratio of catalyst to feed. This extrapolation was somewhat uncertain but indicated a value of 0.2 at the experimental temperature of 1060° F. This is slightly lower than the calculated equilibrium constant for trans-butene-2 but higher than those for cis-butene-2 and butene-1 and appeared to be a reasonable average value which was adopted. The effect of temperature was obtained from the thermodynamic data on heats of reaction, leading to the following approximate equation which should be satisfactory in the 1000-1150° F. temperature range of commercial dehydrogenation operations.

$$\log K = \frac{-28{,}800}{4.575\,T^\circ K} + 6.7532 \quad \ldots\ldots (15)$$

Catalytic Rate Constants. On the basis of assumptions 6, 7, and 8, Equation 2, may be written as follows:

$$r_{m1} = \frac{C_2\left(p_A - \dfrac{p_R p_S}{K}\right)}{[1 + p_A K_A + p_{RS}(K_R + K_S)]^2} \quad \ldots\ldots (16)$$

where,

$$p_{RS} = (p_R + p_S)/2$$

the average partial pressure of hydrogen and butenes. All of the constants in this equation have been evaluated at 1060° F. except $(K_R + K_S)$. If only the catalytic dehydrogenation reaction occurred, this constant could be evaluated by applying an integrated form of Equation 16 to data from a run at low space velocity and high conversion under isothermal and isobaric conditions. Although the catalytic dehydrogenation reaction is always accompanied by other reactions, their contributions may be estimated from Equations 3 and 7 and the net conversion due to the primary catalytic reaction obtained by difference.

In any elementary cross section of catalyst bed the rate of catalytic dehydrogenation is expressed by the following material balance equation:

$$r_{m1} dW = F dx_c \quad \ldots\ldots (17)$$

or

$$\frac{W}{F} = \int_0^{x_c} \frac{dx_c}{r_{m1}} \quad \ldots\ldots (18)$$

where

x_c = moles of butane catalytically dehydrogenated per mole of butane fed. In order to evaluate the integral of Equation 18 it is necessary to express r_{m1} as a function of x_c through Equation 16. If only the catalytic dehydrogenation reaction occurs, the partial pressures corresponding to conversion x_c are:

$$p_A = \frac{1 - x_c}{1 + x_c}\pi; \quad p_R = p_S = \frac{x_c}{1 + x_c}\pi \quad \ldots\ldots (19)$$

Substituting (19) and (16) and combining with (18).

$$\frac{W}{F} = \frac{\pi}{C_2} \int^{x_c} \frac{\left[1/\pi + \dfrac{1 - x_c}{1 + x_c} K_A + \dfrac{x_c}{1 + x_c}(K_R + K_S)\right]^2}{\dfrac{1 - x_c}{1 + x_c} - \dfrac{x_c^2 \pi}{(1 + x_c)^2 K}} dx_c$$

$$= \frac{\pi}{C_2} \int_0^{x_c} \frac{a^2 + 2abx_c + b^2 x_c^2}{1 - \alpha x_c^2} dx_c \quad \ldots\ldots (20)$$

where,

$a = 1/\pi + K_A$

$b = 1/\pi + K_R + K_S - K_A$

$\alpha = 1 + \pi/K$

Integrating, at constant temperature and pressure,

$$\frac{C_2}{\pi}\left(\frac{W}{F}\right) = \left(a^2 + \frac{b^2}{\alpha}\right)\left(\frac{1}{2\sqrt{\alpha}}\right) \ln \frac{1 + x_c\sqrt{\alpha}}{1 - x_c\sqrt{\alpha}} -$$

$$\frac{ab}{\alpha} \ln(1 - \alpha x_c^2) - \frac{b^2 x_c}{\alpha} \quad \ldots\ldots (21)$$

Equation 21 completely relates catalytic conversion to catalyst/feed ratio or space velocity for a reaction in which temperature and pressure are uniform throughout. Equations of this type require a high order of numerical accuracy in their application and are not generally useful for design problems. However, they may be effectively used in the analysis of laboratory data where constancy of temperature and pressure are approximated.

For the reaction under consideration all of the constants in Equation 21 are known with the exception of $(K_R + K_S)$ which appears only in the b term. This constant can be evaluated by application of the equation to any experimentally determined value of x_c and W/F in which a sufficiently high conversion is produced to yield satisfactory accuracy. In order to determine x_c for any experimental run, the observed total conversion x_t must be corrected for the cracking or dealkylation reactions. Thus, on the basis of one mole of butane fed,

$$x_c' = x_t - x_d' \quad \ldots\ldots (22)$$

where

x_c' = moles of butane catalytically dehydrogenated

x_d' = moles of *butane* decomposed by dealkylation reactions.

By integration of Equations 3 and 7 a relationship between x_d' and W/F may be developed.

$$x_d' = \int_0^{W/F} r_{m2} d\left(\frac{W}{F}\right) = k_2 \int_0^{W/F} p_A d\left(\frac{W}{F}\right) \quad \ldots\ldots (23)$$

where p_A = partial pressure of butane, atm.

From the experimental data of Table 1 a curve was plotted relating $k_2 p_A$ as ordinates to W/F. The area under this curve gave values of x_d' as a function of W/F. A curve relating x_c' to W/F was then plotted from Equation 22. On the basis of the assumptions made, this curve represents the catalytic dehydrogenation actually occurring in the experimental reactor. However, this actual conversion differs somewhat from that which would have been produced if no dealkylation reactions had occurred. An approximate correction to estimate this "ideal" catalytic conversion curve to which Equation 21 is applicable may be derived from the following expression, which assumes that the catalytic rate is proportional to the thermodynamic "driving force" term of Equation 2 and neglects variations in the adsorption terms of the denominator:

$$r_{m1} = r_{m1}'\left(\frac{p_A - p_R p_S / K}{p_A' - p_R' p_S' / K}\right) \quad \ldots\ldots (24)$$

where,

r_{m1}' = actual rate of catalytic dehydrogenation corresponding to any value of x_c' in the presence of dealkylation reactions.

r_{m1} = ideal rate of catalytic dehydrogenation corresponding to x_c' if no side reactions had been present

p_A', p_R', p_S' = actual partial pressures of butane, butenes and hydrogen

p_A, p_R, p_S = ideal partial pressures which would correspond to x_c' if no dealkylation reactions had occurred.

The correction factor of Equation 24 was applied to the curve relating x_c' to W/F by a differentiation-integration procedure. It is evident from Equation 17 that the slope of this curve, at any point $dx_c'/d(W/F)$ is equal to r_{m1}. By graphical differentiation a curve was obtained which related r_{m1}' to W/F. Corresponding values of r_{m1} were calculated from Equation 24 and plotted against W/F. The area under this curve was then measured to evaluate x_c as a function of W/F in accordance with the following integrated form of Equation 17:

$$x_c = \int_0^{W/F} r_{m1} d\left(\frac{W}{F}\right) \quad \ldots\ldots (25)$$

A series of values of b and $(K_R + K_S)$ were calculated by applying Equation 21 to several points on the corrected curve relating x_c to W/F in the high conversion range. An average value of $(K_R + K_S)$ of approximately 1.5 was indicated. This completes the evaluation of the constants at 1060° F. in Equations 2 and 3 which are summarized as follows:

$k_2 = 0.002$ $\quad K_A = 0.45$ $\quad C = 0.0676$

$(K_R + K_S) = 1.5$ $\quad K = 0.20$

Effects of Temperature. Proper evaluation of the effects of temperature would require a series of experimental runs such as summarized in Table 1 for at least one other temperature. In the absence of such data it is necessary to estimate the temperature effects from the data of the literaure.

It was assumed that the effect of temperature on the rates of the dealkylation reactions corresponds to the energy of activation of 73,900 cal./g.-mole observed by Paul and Marek[7] for the pyrolysis of *n*-butane. Accordingly, from Equation 7,

$$\log k_2 = \frac{-73{,}900}{4.575T} + 16.43 \quad \ldots\ldots (26)$$

The effects of temperature on the apparent adsorption constants K_A and $(K_R + K_S)$ were estimated on the basis of the approximation suggested by Hougen and Watson[5] that the entropy change of adsorption is −23.0. On this basis,

$$\log K_A = \frac{18{,}073}{4.575T} - \frac{23.0}{4.575} \quad \ldots\ldots (27)$$

$$\log (K_R + K_S) = \frac{20{,}092}{4.575T} - \frac{23.0}{4.575} \quad \ldots\ldots (28)$$

The temperature coefficient of the overall rate constant C_2 was evaluated by applying Equations 9 and 27 to the data of Grosse, Ipatieff, Egloff, and Morrell[4] which is summarized by Beckman, Morrell, and Egloff[2]. These data are presented in the form of curves relating percentage dehydrogenation to space velocity at various constant temperatures ranging from 500° to 675° C. Although the nature of the catalyst is not disclosed in detail it is believed to be sufficiently similar to that employed in this work to permit assumption of similar temperature effects even though the absolute rates of reaction are somewhat different. Accordingly, these data were replotted to relate percentage conversion to W/F, assuming the catalyst to have the same density and void fraction found in this work. The resulting curves were extrapolated to zero and their slopes estimated at the origin. These slopes represent initial reaction rates r_{m1} at the lower temperature where the dealkylation reactions are of minimum importance. A corresponding apparent value of C_2 was calculated at each temperature from Equations 9 and 27 and plotted on a logarithmic scale against $1/T$ as abscissas. An average line through these points was slightly concave upward, as would be expected from the relatively high temperature coefficients of the thermal reactions which as a result become more important at high temperatures. The slope of the curve in the lower temperature range corresponds to an apparent energy of activation of 36,000 cal./g mole. Combining this with Equation 13,

$$\log C_2 = \frac{-36{,}000}{4.575T} + 8.1532 \quad \ldots\ldots (29)$$

The overall equilibrium constant K is expressed as a function of temperature by Equation 15, which is based on reliable thermodynamic data. At high conversions this is the most important term in the rate equation and it is fortunately the most accurately known. The temperature effects expressed by Equations 26, 27, and 28 are very uncertain, but are of less importance in typical design problems.

Integration of Rate Equations

It has been assumed that the complex group of reactions actually occurring in the catalytic dehydrogenation of butane may be approximately represented by consideration of only three simultaneous reactions, 1 the dehydrogenation of butane, 2 the cracking of butane, 3 the cracking of butene. In any elementary section of catalyst bed the extents to which these reactions occur are represented by the following material balance equations:

$$dx_1 = r_{m1}\, d(W/F) \quad \ldots\ldots (30)$$

$$dx_2 = r_{m2}\, d(W/F) = k_2 p_A\, d(W/F) \quad \ldots\ldots (31)$$

$$dx_3 = r_{m3}\, d(W/F) = k_2 p_R d\,(W/F) \quad \ldots\ldots (32)$$

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where

x_1 = moles butane dehydrogenated per mole of feed
x_2 = moles butane cracked per mole of feed
x_3 = moles butene cracked per mole of feed
r_{m1}, r_{m2}, r_{m3} = rates of reactions 1, 2, and 3 (moles)/(mass of catalyst) (hr)
p_A = partial pressure of butane, atm.
p_B = partial pressure of butene, atm.

The rate of dehydrogenation, r_{m1}, is expressed by Equation 2. With the constants in all of the rate equations evaluated, it is possible to simultaneously integrate Equations 30, 31, and 32 to determine the relationship between W/F and the conversions. This integration is best performed by a progressive stepwise procedure in which the reactor is divided into small finite increments. Starting at the inlet, the average partial pressures of butane, butene, and hydrogen are estimated for the first increment of catalyst mass. The conversions in this section are then calculated from Equations 30-32. From the known composition of the feed at the inlet, the composition of the stream leaving the first increment is obtained and the corresponding partial pressures calculated. The arithmetic averages of the partial pressures at the inlet and outlet of the increment are then compared to those originally assumed. Any significant error in the first assumption is corrected by a second approximation based on the calculated partial pressures. Once the conversions and partial pressures at the outlet of the first increment are evaluated the procedure is repeated for the next increment. In this manner complete conversion and partial pressure curves are developed throughout the reactor until the desired conversion or reactor size is reached.

This progressive, stepwise procedure becomes rigorous only when increments of infinitesimal size are used. In practical application little error is introduced by the use of rather large increments except in regions where the partial pressure curves undergo sharp curvature or the rate equations are unusually susceptible to errors in partial pressures. For preliminary estimates it is frequently satisfactory to treat an entire reactor in five steps. For more accurate results from ten to twenty increments are generally satisfactory.

In order to calculate the complete composition and partial pressures of the reactant stream it is necessary to assign product distributions to all reactions. Reaction 1 is considered as producing only equimolal quantities of butenes and hydrogen. Based on the data in the literature[10] for pyrolytic cracking the following product distributions in moles per mole decomposed were arbitrarily assigned to Reactions 2 and 3:

	Reaction 2 Butane Cracking	Reaction 3 Butene Cracking
Butenes	0.1	
Hydrogen	0.1	0.1
Dealkylation Products	1.8	1.8
Polymerization Products		0.1
Total	2.0	2.0

It was assumed that the polymerization products ultimately form catalyst deposit and the total moles of gaseous products from butene was taken as 1.9.

With these product distributions and the experimentally evaluated rate constants an integration was carried out for an isothermal, isobaric reactor at 1060° F. and 1.0 atm. The results are graphically shown in Fig. 6. In Table 2 are comparisons of the calculated conversions with values read from average curves empirically drawn through the data of Table 1 at 1.0 atm. pressure. As previously pointed out, these data are scattered and the average curves not well defined. However, the agreement in Table 2 indicates that the method of calculation gives fair agreement with the empirical curves from which the analysis was started. In Fig. 7 is the selectivity curve from Fig. 6 compared with the experimental points from Table 1. The deviations are probably within the range of the experimental error.

By the same procedure outlined for the derivation of Fig. 6, integrations were carried out at temperatures 1010°, 1060°, and 1110° F. and pressures of 0.2, 1.0, and 3.0 atm. The butene production results are summarized in Fig. 8 and the selectivities in Fig. 9.

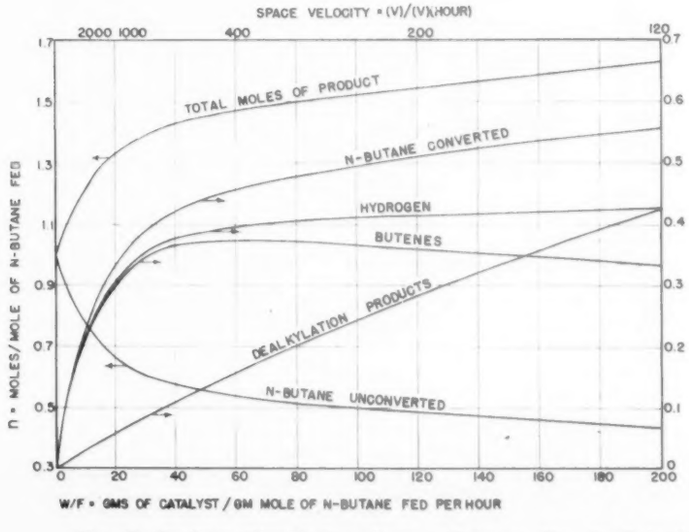
It will be noted that the temperature and pressure relationships which were assigned to the individual reactions lead to a most complex overall pattern. Butene production increases with increased catalyst/feed ratio until a maximum is reached, beyond which butene production is lost. The maximum butene production is increased by increased temperature and reduced pressure. It is evident that high productions per pass of butene cannot be obtained at low temperatures and high pressures. Operations at pressures of 1.0 atm. or higher should be restricted to relatively high space velocities.

Fig. 9 indicates that selectivity is improved markedly by reduced pressure. At low conversions the best selectivities are obtained at low temperatures while at high conversions the reverse is true. This situation arises from the relatively high temperature coefficient assigned to the cracking reaction and from the favorable effect of increased temperature on the equilibrium constant.

TABLE 2—Comparison of Calculated and Experimental Conversions

1060° F.; 1.0 atm.

W.F.	Space Velocity (V)/(V) (Hr.)	Total Moles Exp.	Total Moles Calc.	Butene Converted Exp.	Butene Converted Calc.	Butene Produced Exp.	Butene Produced Calc.
10	2,400	1.21	1.23	0.23	0.23	0.23	0.21
20	1,200	1.33	1.33	0.33	0.34	0.29	0.30
40	600	1.48	1.46	0.42	0.42	0.34	0.37
60	400	1.59	1.55	0.47	0.46	0.35	0.37



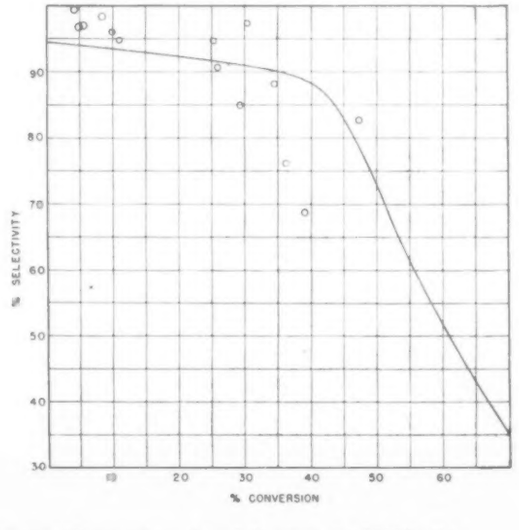


Fig. 6—Product Distribution from n-Butane; Fig. 7—Selectivity vs Conversion ($\pi = 1.0$ atm; $t = 1060°$ F.)

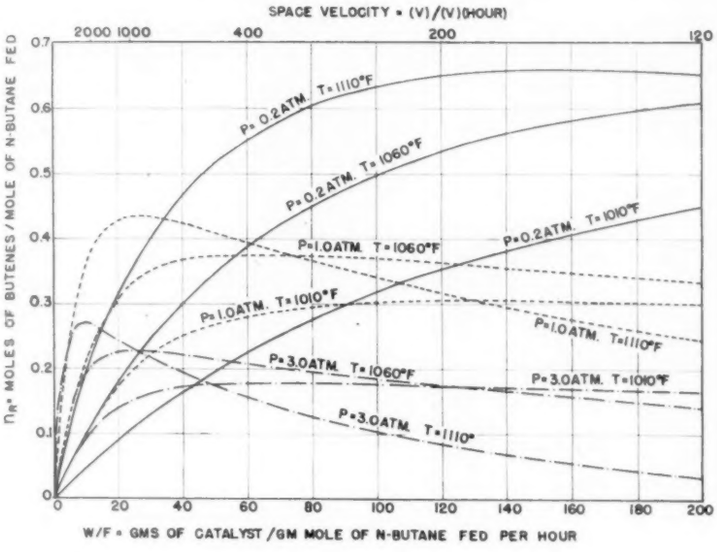


Fig. 8 (above)—Butene Production by Catalytic Dehydrogenation of n-Butane

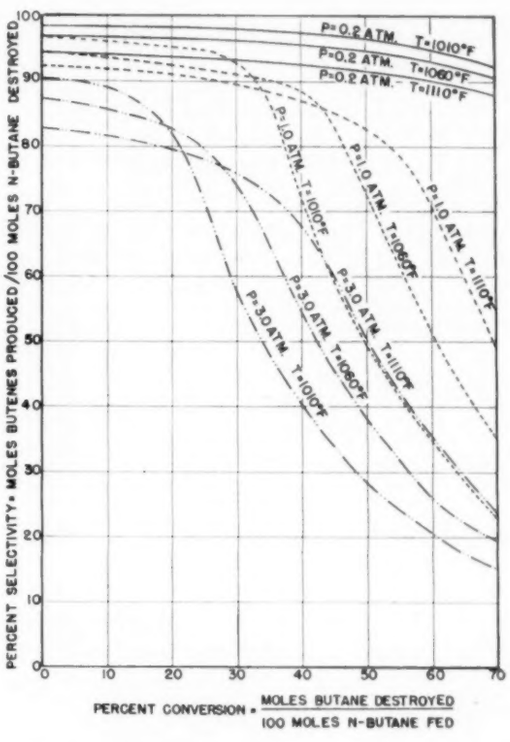

PERCENT SELECTIVITY = MOLES BUTENES PRODUCED / 100 MOLES N-BUTANE DESTROYED
P=0.2 ATM. T=1010°F
P=0.2 ATM. T=1060°F
P=0.2 ATM. T=1110°F
P=1.0 ATM. T=1010°F
P=1.0 ATM. T=1060°F
P=1.0 ATM. T=1110°F
P=3.0 ATM. T=1010°F
P=3.0 ATM. T=1060°F
P=3.0 ATM. T=1110°F
PERCENT CONVERSION = MOLES BUTANE DESTROYED / 100 MOLES N-BUTANE FED

Fig. 9 (right)—Selectivities in Catalytic Dehydrogenation of n-Butane

It is probable that the effects of both temperature and pressure are somewhat exaggerated by the assumptions made in developing Fig. 9. The temperature coefficient assigned to the cracking reactions is probably too high. Similarly, it is probable that these reactions do not reduce in rate in direct proportion to reductions in pressure. These errors would both minimize the large advantages in selectivity which are shown for operations at low temperatures in the low conversion range and for low pressures in the high conversion range. However, it is believed that these probable errors are not serious over the range investigated and that the general trends and conclusions are reasonably firm.

Commercial Reactor Design

The integrations from which Figs. 8 and 9 were developed are limited to the hypothetical case of an isothermal, isobaric reactor. Commercial reactors all involve significant pressure drops. The temperature variations depend on the type of reactor. If the catalyst is in small tubes surrounded by a heat exchange medium, a fair approach to isothermal conditions is obtained. If it is in a large diameter reactor without heat exchange, it may be treated as adiabatic. Design problems for either of these types of reactors are readily handled by the progressive integration already described. The pressure drop in each increment of catalyst bed is calculated from the average conditions. The correlation of Oman and Watson[6] may be used for this purpose. In this manner a pressure distribution curve is developed as a part of the integration. Similarly, in an adiabatic reactor the temperature drop in each increment is calculated from the conversion and the thermochemistry of the reaction. A complete temperature distribution curve results.

The case of a reactor comprising a large diameter tube surrounded by a heat transfer medium offers serious difficulties because of the temperature differences which exist both radially and longitudinally. It is evident from Figs. 8 and 9 that such radial temperature differences are particularly undesirable in their effect on selectivity. Calculation of the temperature distribution in such a reactor is a complex problem for which no simple and generally satisfactory solution is yet available. Wilhelm, Johnson, and Acton[11] present a method which is simple but involves doubtful assumptions and requires data not ordinarily available. Experimental investigation of the temperature gradients in a single tube is desirable as a basis for the design of such a reactor. Similarly, specific temperature distribution data are required for the regenerative type of reactor in which the temperature of the catalyst during a short process period is maintained by storage of heat from the previous regeneration period. If a basis for estimating the temperature distributions is established the results of such reactors may be predicted by the progressive integration already described.

Once a method for predicting the results of a specified reactor is developed, selection of the optimum design and operating conditions becomes a more or less routine problem of setting up a carefully selected series of design cases involving systematic variations of design features and operating conditions. Preliminary economic studies to determine the capital, raw material, labor, utility, maintenance and overhead costs for each case must then be carried out. The results are analyzed to estimate the conditions of the optimum case which is then verified by more detailed engineering studies.

Acknowledgments

The work here described was made possible through the Gulf Oil Corp. fellowship in chemical engineering and the additional financial support of the Wisconsin Alumni Research Foundation. Grateful acknowledgment is made of the cooperation of the Phillips Petroleum Co. in supplying the catalyst and hydrocarbons and of the Universal Oil Products Co. in making available a portion of the experimental equipment. The hydrocarbon charging equipment and the product handling system were jointly developed for this and another project sponsored by the Office of the Rubber Director and the Rubber Reserve Co. Messrs. L. H. Beckberger, W. C. Howe, and C. C. Klosterman cooperated in these joint developments.

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PERSONALS

PETROLEUM TECHNOLOGISTS IN THE HEADLINES

Mr. Baker

Mr. Denne, Jr.

A. L. Baker has been elected vice-president of the Kellex Corp., and **W. H. Denne, Jr.**, general manager of the same company. The Kellex Corp. is the subsidiary of the M. W. Kellogg Co., process engineers, New York, which engineered the Oak Ridge, Tenn., atom bomb plant.

Originally formed on a war duration basis for the sole purpose of completing the atom bomb project, the Kellex Corp. developed a wide range of new scientific methods, procedures and equipment in that work. Its technical skill and experience now is to be made available to both government and industry in the advanced scientific fields.

Mr. Baker, as general manager of Kellex, played a leading part in engineering the Oak Ridge plant for the production of Uranium 235. He went to Bikini to serve as a special representative at Operation Crossroads. He joined the M. W. Kellogg Co. in 1934 and specialized in development work on the Fluid process.

Mr. Denne served throughout the war as chief of the Contracts Division of Kellex. In his new position he will have charge of all non-technical activities and general administration of the company.

° ° °

In a reorganization of the manufacturing department of Shell Chemical Corp., **Dr. C. W. Humphreys** becomes manager of the operations department and **F. Kortlandt** assistant manager. Dr. Humphreys has been manager of Shell's Houston refinery. The present development and engineering department of Shell Chemical is being split into separate departments. **M. Buck** continues as manager of development and **L. M. Roberts**, assistant manager, becomes manager of the engineering department. **M. R. Sprinkle**, Wood River, has been appointed assistant manager, development, and **E. S. Robb**, Houston, takes the assistant managership of the engineering department.

B. M. Downey, now manager of Shell's Dominguez refinery, moves to Houston as plant manager and **J. G. Bejarano** becomes manager at Dominguez.

Dr. Herbert H. Uhlig has been appointed associate professor in the Department of Metallurgy of Massachusetts Institute of Technology to be in charge of its new co-ordinated program of instruction and research in corrosion of metals. Organization of the program as a project in which the resources of all departments will be brought to bear is expected to expedite the search for methods of preventing or controlling corrosion. In the oil industry alone, it is stated, estimated loss from corrosion in refineries is approximately $125,000,000 a year and $50,000,000 in pipe lines.

Dr. Uhlig graduated from Brown University in 1929 and received his doctorate at M. I. T. in 1932. After a few years of industrial work he joined the M. I. T. research staff in 1937 to direct a project dealing with the corrosion of stainless steel. Later he engaged in similar work with General Electric Co. He joined the M. I. T. teaching staff July 1.

° ° °

Joseph C. Alther, formerly vice president and director of Universal Oil Products, has resigned from the company after 30 years of service and established a consulting office in Chicago. His resignation was accepted by the board of directors in May 1945, but Alther agreed to remain available as a consultant to the company for one year, which terminated May 31.

° ° °

T. C. Dauphine, former research engineer for California Research Corp., has been named eastern manager of product development for Oronite Chemical Co., a subsidiary of Standard Oil Co. of Calif.

° ° °

Dr. Claude Peavy has been appointed head of the Process Design Division of Houdry Process Corp., which is being expanded, particularly to serve the smaller refineries. Dr. Peavy has a background of experience in process design in catalytic cracking as well as allied petroleum refining fields which extends over 17 years. He was formerly chief process engineer in the Refinery Engineering Division of Socony-Vacuum Oil Co., Inc., and he also served for nine years as process engineer with E. B. Badger and Sons Co. He is a native of Texas and received his professional engineering training at the University of Michigan.

Dr. Peavy

Dr. F. J. Sanders has been appointed to the newly created position of Technical Manager on the home office staff of Standard Oil Co. (Ohio). He was formerly superintendent of the company's No. 2 refinery in Cleveland. In his new position, which he assumed July 1, Dr. Sanders will act as manager of Sohio's technical organizations, including general engineering technical service, chemical research, and fuels and lubricants, and will report to Elliott B. McConnell, general manager of the manufacturing department.

Dr. Sanders

Succeeding Dr. Sanders as manager of the No. 2 refinery is **Forest G. Brown.** Mr. Brown previously managed Standard's can factory, and will continue to do so in addition to assuming his new duties.

° ° °

Harry Brown has been appointed superintendent and **J. R. Penisten** assistant superintendent of Frontier Refining Co. at Cheyenne, Wyo. Both formerly were with Universal Oil Products Co.

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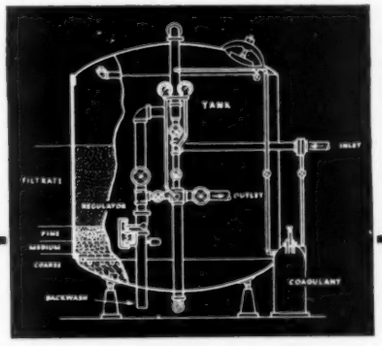

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WIDENING HORIZONS

Views on Personnel, Management and Economic as Well as Technological Developments in Petroleum Refining and Natural Gas Processing: Comment from Readers is Invited

Technology at Work to Insure True Conservation of Natural Gas

THE petroleum industry may find it necessary to revise its ideas as to the importance of our natural gas reserves both as potential sources of synthetic chemicals and liquid fuels sooner than it has anticipated. Now coming to light are the technological advances of the past few years which have established more valuable uses for gas than as a fuel. These advances have significance particularly for refiners and natural gasoline manufacturers.

Data presented by various authorities before recent hearings of the Federal Power Commission emphasize that hydrocarbons from natural gas and petroleum are becoming the principal raw material of the synthetic chemical industry. "Since the early 20's a conspicuous development has centered on the non-coal tar organic compounds known as aliphatics derived in increasing quantity from natural gas," Warren N. Watson, secretary of the Manufacturing Chemists Assn., told a FPC hearing June 10.

"An entirely new industry has been developed based on the use of the components of natural gas as raw material. This is the industry for the manufacture of synthetic organic chemicals, and the growth of this business has been so rapid that few have fully appreciated its influence on present economic life, or the role that natural gas plays in the chemical industry."

"The chemical industry is dependent upon natural gas as one of its most important sources of raw material," he stated, "and the natural gas industry has in the chemical field one of its most important and rapidly expanding customers and one in which the natural gas consumed is utilized with high efficiency in maintaining the economic prosperity of the country."

The growth in this country of the non-coal tar synthetic manufacture was emphasized by Harold Vagtborg, president, Midwest Research Institute, Kansas City, speaking before the Wichita section of the American Chemical Society. Of the production of synthetics in 1944 of nearly 10 billion pounds, nearly six billion were non-coal tar chemicals, he said. "Although the coal tar synthetics have increased in production several fold in the past 20 years, the non-coal tar synthetics, which are chemicals, which could be produced from natural gas, have increased many fold," he also said.

For purposes of comparison with other manufacturing industries, Mr. Vagtborg showed steel production in 1944 was 178 billion pounds and of aluminum two billion pounds.

"It is well to emphasize that coal, petroleum and natural gas are comprised largely of the same basic chemical substances," Mr. Vagtborg said, "and that in chemical synthesis they are all interchangeable. What is becoming increasingly evident is that products which have heretofore been made of coal or coal tar are more easily made from petroleum and natural gas. This is due to the fact that petroleum and gas are mixtures of valuable chemical materials in a form more easily processed and separated than is the case with coal and coal tars."

"In considering petroleum refining and the relation of some of its by-products to natural gas", said Mr. Vagtborg at another point, "it is interesting to show that refinery gases have the edge over natural gas in that with the former the reactive compounds have already been prepared, whereas in the case of natural gas it is necessary to take a preliminary processing step.

"In this entire matter of chemical synthesis and the chemical uses of gas and petroleum, the petroleum industry is confronted with the problem of whether or not its individual operators want to get into entirely new industries with the great diversification of sales outlets and the attendant problems. In other words, the petroleum industry has had an entirely new vista opened to it. The exclusive operations of the past are now only a small part of the overall picture."

Several instances have been cited of the present commercial manufacture by petroleum refiners or allied concerns of synthetic chemicals from natural gas and refinery gas. A new development along this line reported in this issue (pg. R-483) is the use of natural gas by the Lion Oil Co. of Arkansas, together with air and water, to produce principally ammonium nitrate fertilizer. Other chemicals can also be obtained by this synthesis, such as ammonia, methanol, nitric acid and others.

The commercial manufacture of synthetic chemicals from natural gas thus far has included only the use of various components extracted from the gas, in most instances without detracting from the value of the remaining portion for fuel purposes and without appreciably affecting the heating value of the gas. This has been but a relatively small factor in the total consumption of natural gas. A more recent development of an entirely different nature is the conversion, by an adaptation of the Fischer-Tropsch process, of natural gas into motor gasoline and other liquid fuels. This so-called Hydrocol process is described in another article in the present issue, (pg. R-506). The economic effect of this or other methods for the conversion of the primary fraction of natural gas, methane, would be to approximately double our present known liquid fuel reserves, it is pointed out.

The inventor of the Hydrocol process, P. C. Keith, president of Hydrocarbon Research, Inc., New York, presented data on the subject before the Federal Power Commission hearings on natural gas. He stated that U. S. natural gas reserves, now estimated at 185 trillion cubic feet, if converted to liquid fuels, would amount to 25 billion barrels, as against present known reserves of crude in the ground of around 21 billion barrels. His basis of comparison is 10,000 cubic feet of gas as equivalent to 1 barrel of synthetic crude and 1 barrel of synthetic crude as equivalent to 1.4 barrels of crude petroleum in terms of recoverable products.

It is too early yet to say how soon methods for securing a higher value for natural gas than as fuel will be generally commercially applied. As has previously been demonstrated in the petroleum industry, however, it is already evident that technological advances are establishing potentially higher values for gas, as raw material. This in turn will secure more effective conservation of this natural resource than the so-called conservation statutes can bring about.

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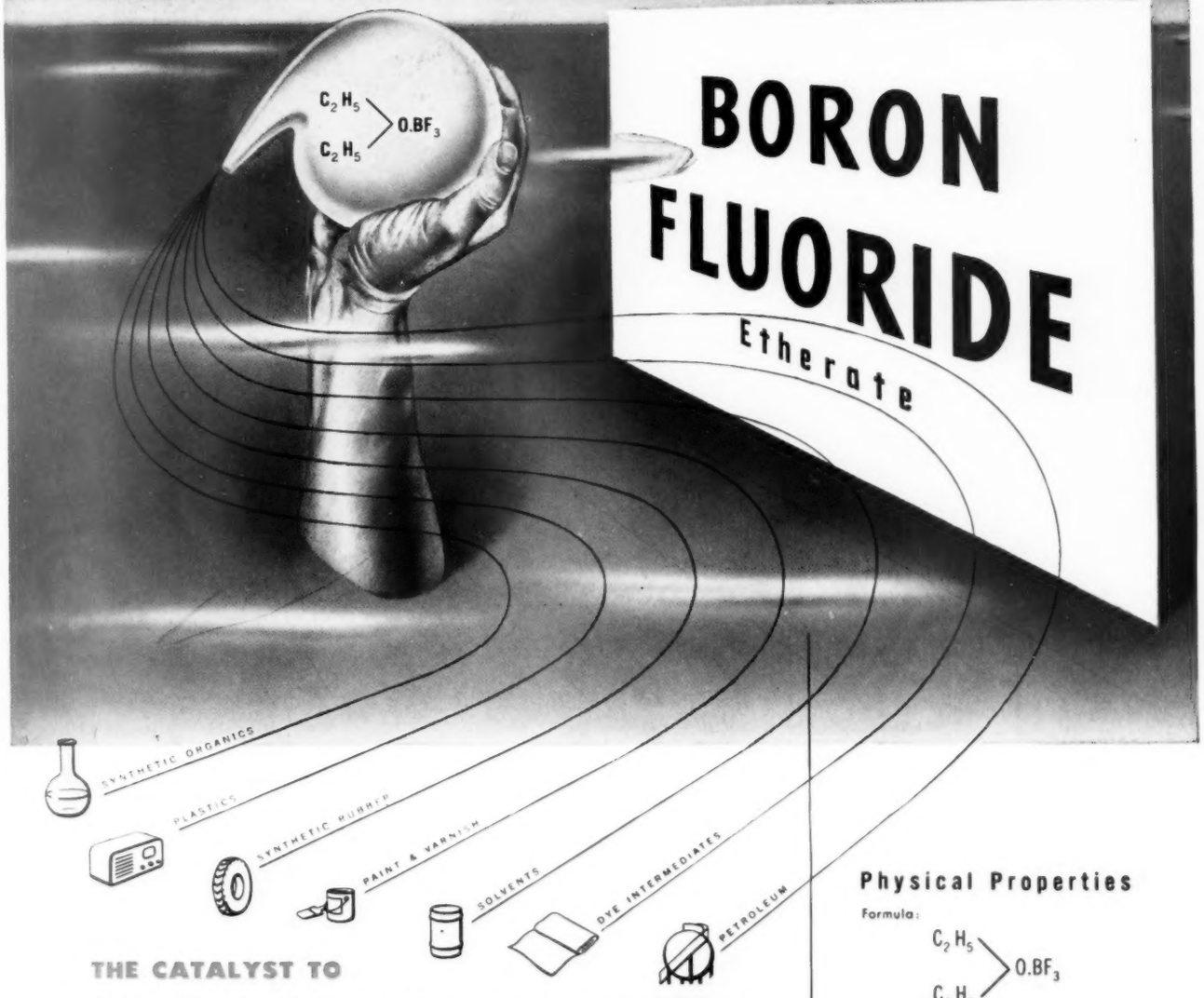

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C_2H_5

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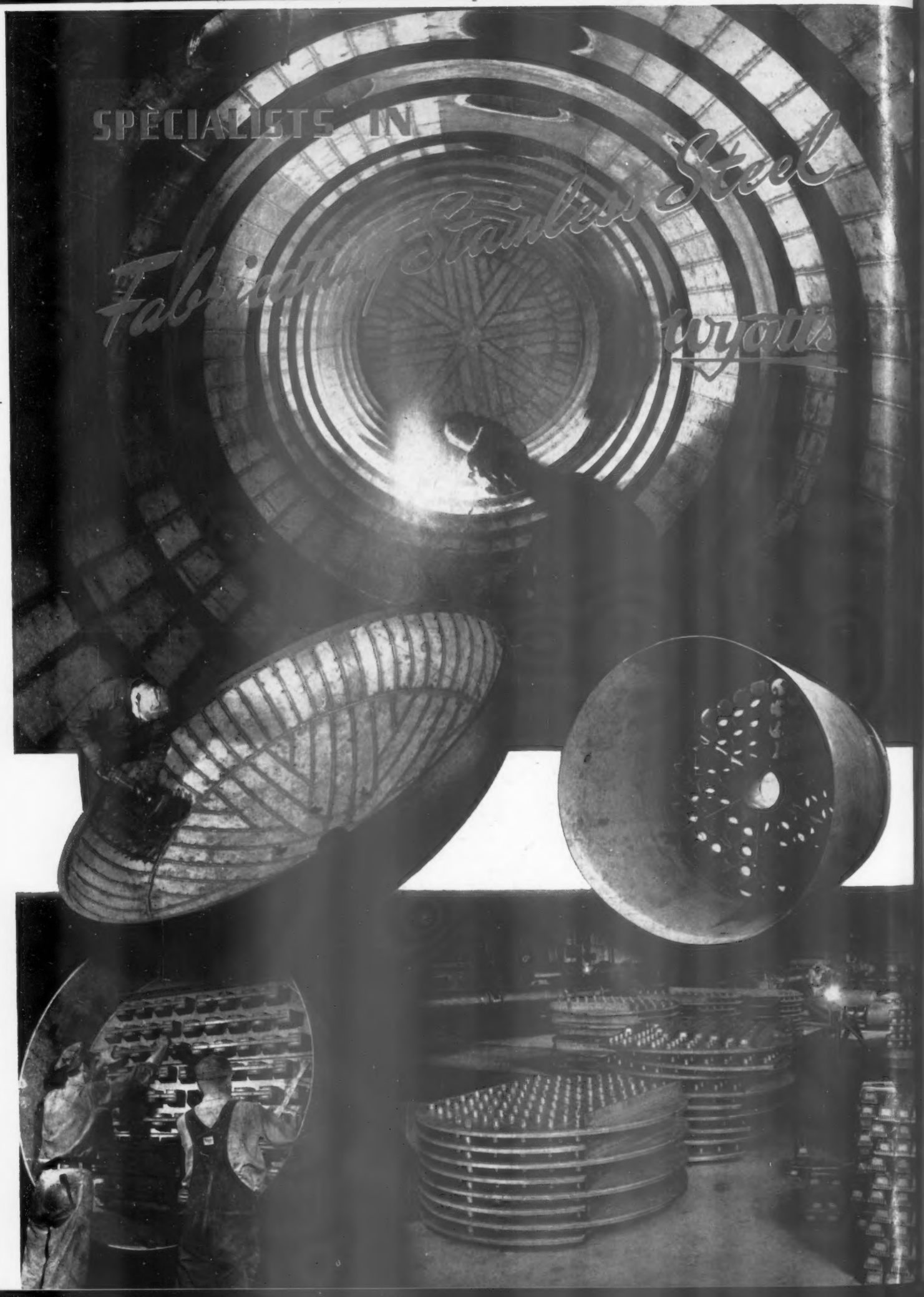
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